United States Department of Agriculture

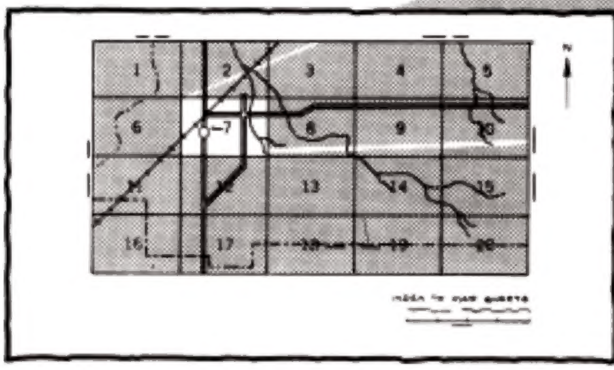
Soil Conservation Service

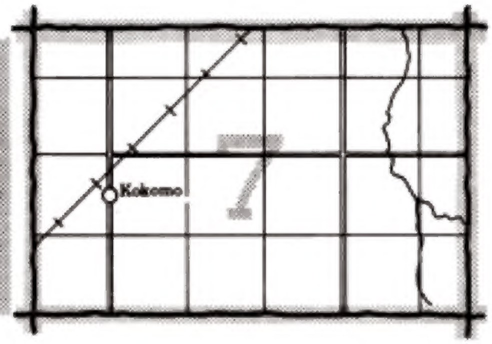
In Cooperation with Arizona Agricultural Experiment Station

Soil Survey of Coconino County Area Arizona Central Part

HOW TO USE

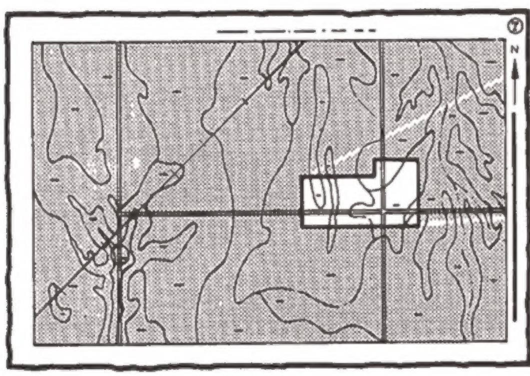
1. Locate your area of interest on the "Index to Map Sheets"

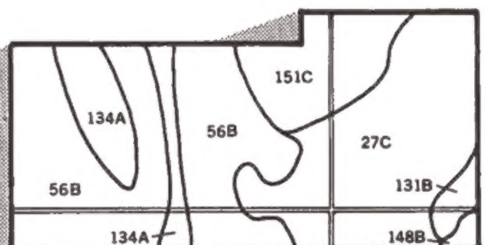




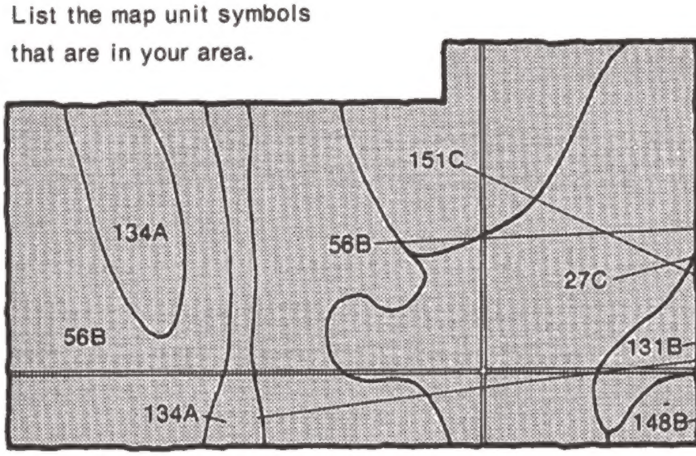
2. Note the number of the map sheet and turn to that sheet.

3. Locate your area of interest on the map sheet.





4. List the map unit symbols that are in your area.

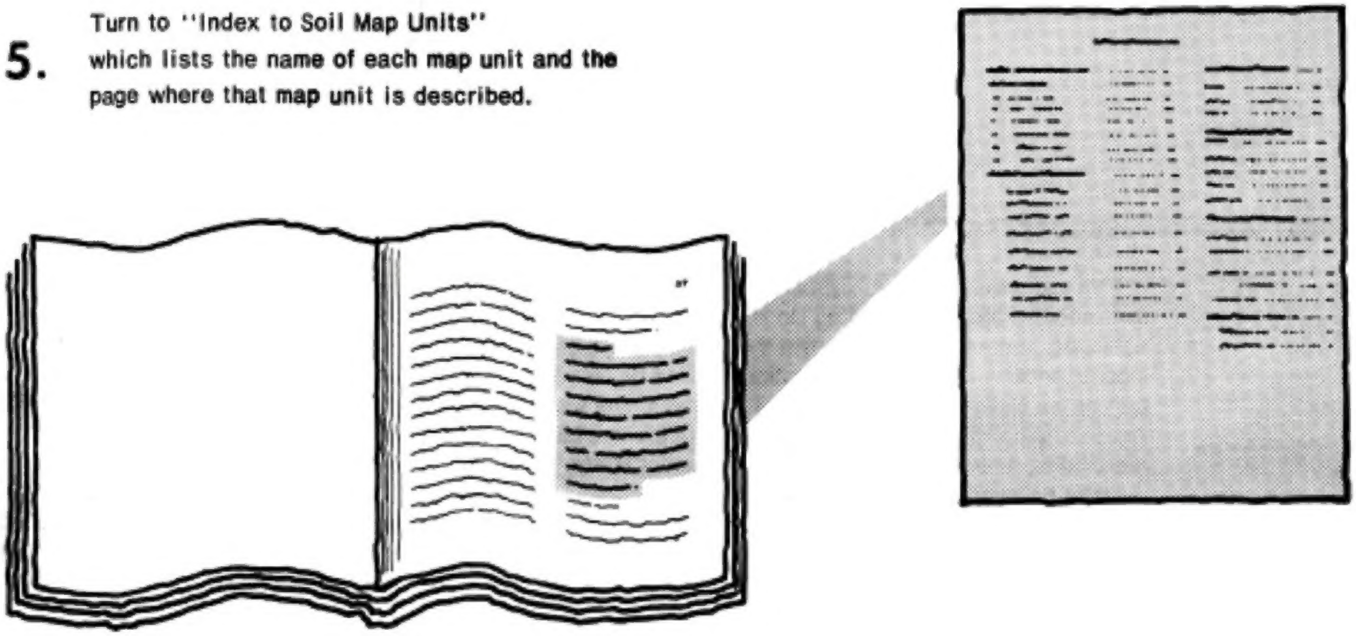


Symbols

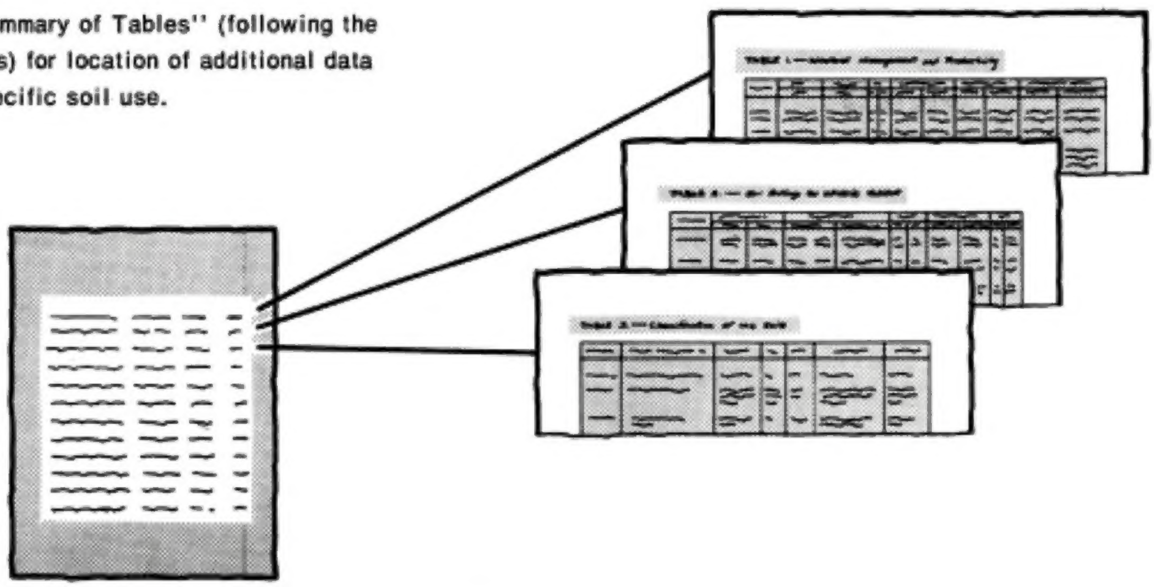
27C
56B
131B
134A
148B
151C

THIS SOIL SURVEY

5. Turn to "Index to Soil Map Units" which lists the name of each map unit and the page where that map unit is described.



6. See "Summary of Tables" (following the Contents) for location of additional data on a specific soil use.



7. Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; to specialists in wildlife management, waste disposal, or pollution control.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was performed in the period 1972-79. Soil names and descriptions were approved in 1980. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1980. This survey was made cooperatively by the Soil Conservation Service and the Arizona Agricultural Experiment Station. It is part of the technical assistance furnished to the Coconino Natural Resource Conservation District.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

Cover: Area of Wukoki-Wupatki very cindery loams, 15 to 60 percent slopes. SP Mountain, a volcanic crater, dominates the landscape.

contents

soil series

Issued August 1983

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summary of tables

foreword

This soil survey contains information that can be used in land-planning programs in Coconino County Area, Central Part. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, ranchers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

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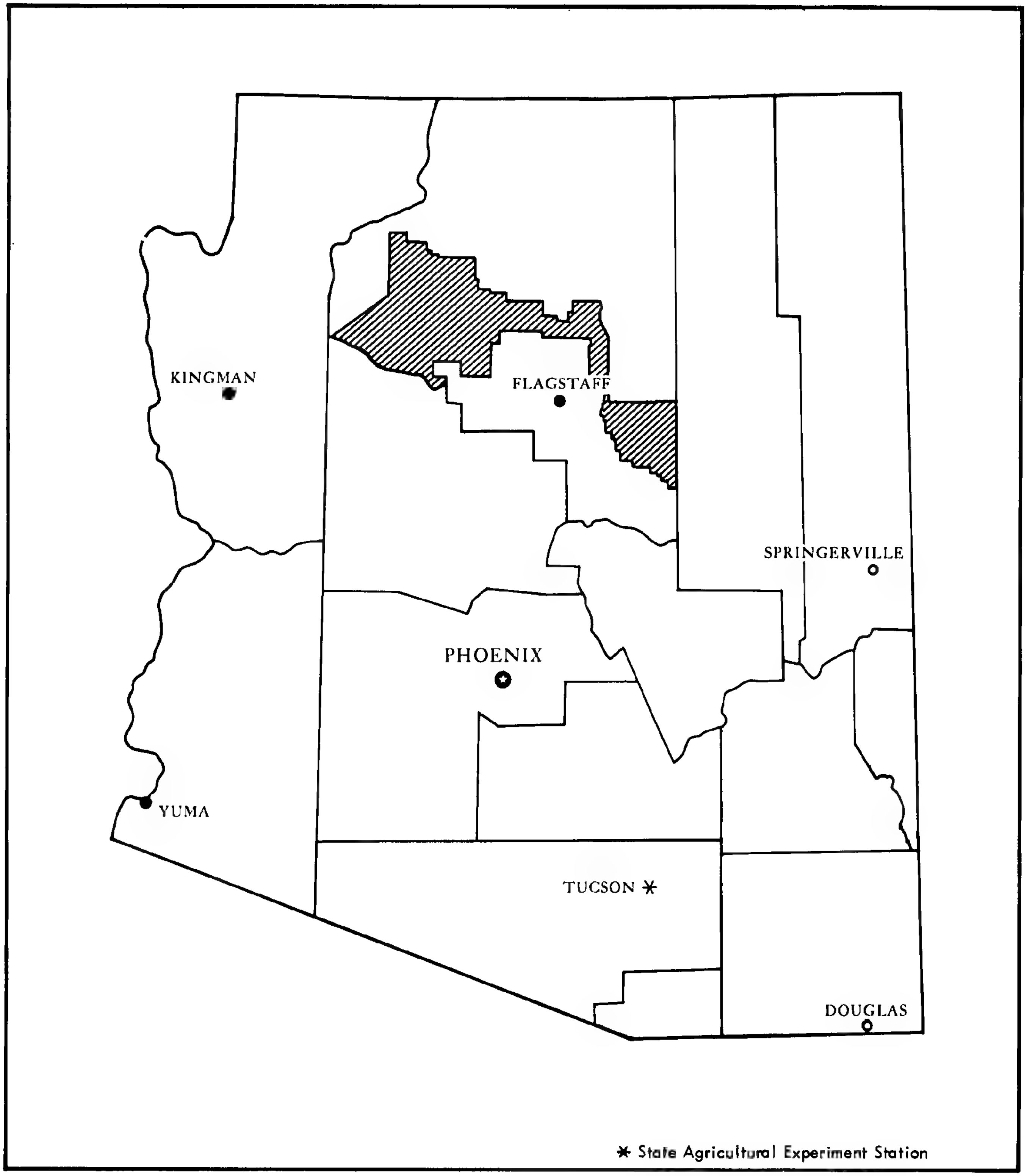

Location of Coconino County Area, Arizona, Central Part.

soil survey of
Coconino County Area, Arizona Central Part

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United States Department of Agriculture, Soil Conservation Service
in cooperation with
Arizona Agricultural Experiment Station

COCONINO COUNTY AREA, CENTRAL PART, is in the north-central part of Arizona. The total area is 2,314,000 acres, or 3,616 square miles. The survey area includes essentially all privately owned and state administered land south of the Colorado and Little Colorado Rivers in Coconino County. It also includes scattered tracts of the Wupatki National Monument and land administered by the Bureau of Land Management.

The survey is divided into two units. The largest, or northern unit, is bounded on the north and east by the Kaibab National Forest and the Havasupai and Navajo Indian Reservations, on the south by the Kaibab and Coconino National Forests and Yavapai County, and on the west by the Hualapai Indian Reservation. The southern unit is bounded on the north by the Navajo Indian Reservation, on the east by Navajo County, and on the south and west by the Coconino and Apache-Sitgreaves National Forests.

Elevation in the survey area ranges from 4,500 to 7,000 feet.

Ranching is the main enterprise in the survey area. Rangeland and grazable woodland make up more than 99 percent of the area, and urban land makes up less than 1 percent. Beef cattle are the principal ranching stock in the area, but some sheep are also raised.

Fifty percent or more of the soils in the survey area formed in material derived from Kaibab Limestone. These soils are undulating to rolling and are on plateaus and mesas. The soils in the eastern part of the area are derived from Chinle Shale and Moenkopi Shale. Soils that formed in material derived from Coconino Sandstone and Supai Sandstone are on hillsides in the southwestern part of the area. Some soils on plateaus and mesas in the extreme southwestern part of the area are derived from Redwall Limestone.

Basalt flows occur throughout the area as relatively flat mesas. Cinder cones and andesite mountains are scattered over the basalt mesas. Nearly all of the basalt flows overlie sedimentary rock. Scattered areas of outwash are on fan terraces in the southwestern part of the survey area. They occur as a gravelly mantle overlying eroded remnants of shale, limestone, and sandstone.

Descriptions, names, and delineations of soils in this soil survey do not fully agree with soil maps in adjacent surveys published at a different date. Differences are the result of better knowledge of soils, modifications in series concepts, intensity of mapping, and the extent of the soils within the survey. In some places it is more feasible to combine small acreages of similar soils that respond to use and management in much the same way than it is to separate these soils and give them names.

general nature of the survey area

This section briefly discusses the settlement and development, transportation, natural resources, and climate of the survey area.

settlement and development

Indians have lived in the survey area for centuries. In the latter part of the 19th century the area was settled by ranchers. The lush grass and the cold winters and warm summers made the area ideal for raising beef cattle and sheep.

The towns of Valle and Red Lake, each of which has a population of less than 500, are in the area. Flagstaff, which has a population of 33,000, is outside the survey area, near the center of Coconino County.

transportation

The survey area is traversed east and west by Interstate 40 and by the Atchison, Topeka, and Santa Fe Railroad. Arizona Highways 64 and 87 and U.S. Highways 89 and 180 are connecting routes that run generally in a north-south direction. Several airlines serve Pulliam Airport in Flagstaff.

natural resources

Soil is the most important natural resource in the survey area. The economy is based mainly on the production of forage and feed for livestock. Cinders are available in the area and are a good source of cover for icy winter roads. They are also used in the construction of cinder blocks. The Tenorio soils are a good source of sand and gravel. In recent years there has been increasing use of the pinyon-juniper woodland in the area as a source of firewood.

climate

Prepared by the National Climatic Center, Asheville, North Carolina.

Summers in the survey area are warm, especially at the lower elevations, and winters are cold. Precipitation is usually light at the lower elevations throughout the year. Precipitation is much greater at the higher elevations, where snow accumulates to a considerable depth. Some of the snowmelt is used for irrigating crops in nearby valleys outside the survey area.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Seligman in the period 1951-75. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter, the average temperature is 38 degrees F and the average daily minimum temperature is 22 degrees. The lowest temperature on record, which occurred at Seligman on December 22, 1968, is -12 degrees. In summer, the average temperature is 71 degrees and the average daily maximum temperature is 90 degrees. The highest recorded temperature, which occurred at Seligman on June 22, 1954, is 104 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (40 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is 12 inches. Of this, 7 inches, or 65 percent, usually falls in April through September, which includes the growing season for most crops. In 2 years out of 10, the rainfall in April through September is less than 5 inches. The heaviest 1-day rainfall during the period of record was 4.84 inches at Seligman on July 21, 1970. Thunderstorms occur on about 50 days each year, and most occur in summer.

The average seasonal snowfall is 13 inches. The greatest snow depth at any one time during the period of record was 10 inches. On an average of 2 days, at least 1 inch of snow is on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 35 percent. Humidity is higher at night, and the average at dawn is about 70 percent. The sun shines 80 percent of the time possible in summer and 75 percent in winter. The prevailing wind is from the south-southwest. The average windspeed is highest, 9 miles per hour, in April.

Every few years a blizzard accompanied by high winds and much drifting snow strikes the survey area. Even at the lower elevations, snow remains on the ground for many weeks.

how this survey was made

Soil scientists made this survey to learn what soils are in the survey area, where they are, and how they can be used. They observed the steepness, length, and shape of slopes; the size of streams and the general pattern of drainage; the kinds of native plants or crops; and the kinds of rock. They dug many holes to study soil profiles. A profile is the sequence of natural layers, or horizons, in a soil. It extends from the surface down into the parent material, which has been changed very little by leaching or by plant roots.

The soil scientists recorded the characteristics of the profiles they studied and compared those profiles with others in nearby counties and in more distant places. They classified and named the soils according to nationwide uniform procedures. They drew the boundaries of the soils on aerial photographs. These photographs show trees, buildings, fields, roads, and other details that help in drawing boundaries accurately. The soil maps at the back of this publication were prepared from aerial photographs.

The areas shown on a soil map are called map units. Most map units are made up of one kind of soil. Some are made up of two or more kinds. The map units in this survey area are described under "General soil map units" and "Detailed soil map units."

While a soil survey is in progress, samples of some soils are taken for laboratory measurements and for engineering tests. All soils are field tested to determine their characteristics. Interpretations of those characteristics may be modified during the survey. Data are assembled from other sources, such as test results, records, field experience, and state and local specialists.

But only part of a soil survey is done when the soils have been named, described, interpreted, and delineated on aerial photographs and when the laboratory data and other data have been assembled. The mass of detailed information then needs to be organized so that it can be used by farmers, rangeland and woodland managers, engineers, planners, developers and builders, home buyers, and others.

general soil map units

The general soil map at the back of this publication shows broad areas that have a distinctive pattern of soils, relief, and drainage. Each map unit on the general soil map is a unique natural landscape. Typically, a map unit consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one unit can occur in other units but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one map unit differ from place to place in slope, depth, drainage, and other characteristics that affect management.

The soils in this survey area have been grouped into map units for broad interpretive purposes. Each of the map units is described in the following pages.

1. Epikom-Tours-Purgatory

Shallow to deep, well drained, nearly level to moderately steep soils; on plateaus, mesas, and alluvial fans

This map unit is in the eastern part of the survey area and in the vicinity of Wupatki National Monument. It is mainly on plateaus, mesas, and alluvial fans intermingled with buttes and escarpments. Slope is 0 to 15 percent. The vegetation on the Epikom soils is mainly black grama, blue grama, galleta, and fourwing saltbush. The vegetation on the Tours soils is mainly alkali sacaton, galleta, blue grama, and Indian ricegrass. The vegetation on the Purgatory soils is mainly gyp dropseed, galleta, alkali sacaton, and Mormon-tea. Elevation is 4,500 to 5,600 feet. The average annual precipitation is about 6 to 10 inches, the average annual air temperature is 52 to 55 degrees F, and the average frost-free season is 150 to 175 days.

This unit makes up about 10 percent of the survey area. It is about 60 percent Epikom soils, 12 percent Tours soils, and 12 percent Purgatory soils. The remaining 16 percent is components of minor extent.

Epikom soils are on plateaus and mesas. These soils are shallow and well drained. They formed in alluvial and eolian deposits derived dominantly from sandstone and sandy shale. The soils are loamy and are underlain by sandstone at a depth of 10 to 20 inches.

Tours soils are on alluvial fans. These soils are deep and well drained. They formed in mixed alluvium. The soils are loamy and silty throughout and extend to a depth of 60 inches or more.

Purgatory soils are on plateaus and mesas. These soils are moderately deep and well drained. They formed in alluvial and eolian deposits derived dominantly from gypsiferous sandy shale. The soils are highly gypsiferous, are loamy, and are underlain by weathered shale at a depth of 20 to 40 inches.

Of minor extent in this unit are Ives, Navajo, and Winona soils; Badland; Riverwash; Torrifluvents, saline; Torriorthents; and Rock outcrop.

This unit is used as rangeland and for wildlife habitat. The Tours soils can be used for irrigated crops if water is made available.

The main limitations for most uses are depth to bedrock and slope of the Epikom soils, very low available water capacity of the Epikom and Tours soils, a hazard of flooding on the Tours soils, and a hazard of erosion and high content of gypsum in the Purgatory soils.

2. Winona-Tusayan-Boysag

Very shallow to moderately deep, well drained, nearly level to moderately steep soils; on plateaus and mesas

This map unit is in the eastern part of the survey area. Slope is 0 to 15 percent. The vegetation is mainly black grama, blue grama, galleta, and fourwing saltbush. Elevation is 5,000 to 6,200 feet. The average annual precipitation is about 8 to 14 inches, the average annual air temperature is 50 to 54 degrees F, and the average frost-free season is 130 to 175 days.

This unit makes up about 43 percent of the survey area. It is about 64 percent Winona soils, and 12 percent Tusayan and similar soils, and 4 percent Boysag soils. The remaining 20 percent is components of minor extent.

Winona soils are in convex areas of plateaus and mesas. These soils are very shallow and shallow and are well drained. They formed in alluvial and eolian deposits derived dominantly from limestone and calcareous sandstone. In some areas, about 10 to 50 percent of the surface is covered with stones. The soils are limy gravelly loam and are underlain by limestone at a depth of 6 to 20 inches.

Tusayan soils are in concave areas of plateaus and mesas. These soils are moderately deep and well

drained. They formed in alluvial and eolian deposits derived dominantly from limestone and calcareous sandstone. The soils are limy gravelly loam and very gravelly loam and are underlain by limestone at a depth of 20 to 40 inches.

Boysag soils are in concave areas of plateaus and mesas. These soils are shallow and well drained. They formed in alluvial and eolian deposits derived dominantly from limestone and sandstone. The surface layer is loamy. The subsoil is clayey. Unweathered limestone is at a depth of 10 to 20 inches.

Of minor extent in this unit are Epikom, Lynx, Paymaster, and Poley soils and Rock outcrop.

This unit is used as rangeland and for wildlife habitat.

The main limitations for most uses are depth to bedrock, very low to low available water capacity, and a high content of lime in the Winona and Tusayan soils.

3. Poley-Clovis

Deep, well drained, nearly level to sloping soils; on fan terraces

This map unit is scattered throughout the western part of the survey area. The largest area is in Aubrey Valley. Slope is 0 to 8 percent. The vegetation on the Poley soils is mainly blue grama, black grama, needleandthread, and Indian ricegrass. The vegetation on the Clovis soils is mainly sand dropseed, blue grama, needleandthread, and fourwing saltbush. Elevation is 5,000 to 6,200 feet. The average annual precipitation is 12 to 14 inches, the average annual air temperature is 50 to 54 degrees F, and the average frost-free season is 130 to 175 days.

This unit makes up about 6 percent of the survey area. It is about 64 percent Poley soils and 20 percent Clovis and similar soils. The remaining 16 percent is components of minor extent.

Poley soils are on fan terraces. These soils are deep and well drained. They formed in alluvium derived dominantly from limestone, sandstone, and shale. The surface layer is gravelly and loamy. The subsoil is clayey to a depth of 22 inches. Below this to a depth of 60 inches or more the soils are highly limy and are gravelly and loamy.

Clovis soils are on fan terraces. These soils are deep and well drained. They formed in alluvial and eolian deposits derived dominantly from limestone, sandstone, and shale. The surface layer is sandy. The subsoil is loamy to a depth of 17 inches. Below this to depth of 60 inches or more the soils are highly limy and are loamy.

Of minor extent in this unit are Keeseha, Lynx, Mespun, Palma, Pastura, Paymaster, Quivera, Rune, Tenorio, and Tusayan soils.

This unit is used as rangeland and for wildlife habitat. It can be used for irrigated crops if water is made available. The unit is well suited to these uses.

4. Tuweep-Wukoki-Wupatki

Very shallow, shallow, and deep, well drained, nearly level to very steep soils; on plateaus, mesas, hillsides, and fan terraces

This map unit is in the northeastern part of the survey area. The unit is characterized by nearly level to steep plateaus, mesas, and fan terraces intermingled with moderately steep to very steep hillsides. Slope is 0 to 60 percent. The vegetation is mainly alkali sacaton, galleta, black grama, and blue grama. Elevation is 4,800 to 6,800 feet. The average annual precipitation is about 8 to 14 inches, the average annual air temperature is 52 to 55 degrees F, and the average frost-free season is 150 to 175 days.

This unit makes up about 4 percent of the survey area. It is about 35 percent Tuweep soils, 31 percent Wukoki soils, and 21 percent Wupatki soils. The remaining 13 percent is components of minor extent.

Tuweep soils are on plateaus and mesas. These soils are deep and well drained. They formed in alluvium derived dominantly from basalt and pyroclastics. About 50 percent of the surface is covered with gravel. The soils are highly limy and are loamy throughout. They extend to a depth of 60 inches or more.

Wukoki soils are on hillsides and fan terraces. These soils are deep and well drained. They formed in pyroclastics. The soils are very cindery and loamy and are underlain by cinders at a depth of 18 inches. They extend to a depth of 60 inches or more.

Wupatki soils are on hillsides and fan terraces. These soils are very shallow and shallow and are well drained. They formed in pyroclastics. The surface layer and subsoil are very cindery and loamy. A strongly cemented, cindery hardpan is at a depth of 16 inches. It is underlain by cinders that extend to a depth of 60 inches or more.

Of minor extent in this unit are Lomaki and Nalaki soils, Lava flows, and Rock outcrop.

This unit is used as rangeland, for wildlife habitat, and as a source of cinder gravel.

The main limitations for most uses are the high lime content of the Tuweep soils and the low available water capacity and slope of the Wukoki and Wupatki soils.

5. Disterheff-Rune

Deep, well drained, nearly level to moderately steep soils; on fan terraces, hillsides, stream terraces, and alluvial fans

This map unit is in the western part of the survey area. Slope is 0 to 15 percent. The vegetation on the Disterheff soils is mainly galleta, black grama, blue grama, and sideoats grama. The vegetation on the Rune soils is mainly alkali sacaton, blue grama, western wheatgrass, and fourwing saltbush. Elevation is 5,000 to 6,000 feet. The average annual precipitation is about 11 to 16 inches, the average annual air temperature is 50 to 54 degrees F, and the average frost-free season is 130 to 170 days.

This unit makes up about 7 percent of the survey area. It is about 60 percent Disterheff soils and 35 percent Rune soils. The remaining 5 percent is components of minor extent.

Disterheff soils are on fan terraces and hillsides. These soils are deep and well drained. They formed in pyroclastics and in alluvium derived dominantly from basalt and quartzite. From 20 to 50 percent of the surface is covered with gravel. The surface layer is gravelly and loamy. The subsoil is gravelly and clayey to a depth of 24 inches. Below this to a depth of 60 inches or more the soils are very gravelly and cobbly, are loamy, and are high in content of lime.

Rune soils are on stream terraces and alluvial fans. These soils are deep and well drained. They formed in mixed alluvium derived dominantly from basalt, sandstone, and limestone. The soils are clayey throughout and extend to a depth of 60 inches or more.

Of minor extent in this unit are Daze, Deama, Lynx, Pastura, Paymaster, and Showlow soils.

This unit is used as rangeland and for wildlife habitat. The Rune soils can be used for irrigated crops if water is made available.

The main limitation for most uses is the rare periods of flooding on the Rune soils in winter and spring.

6. Deama-Tovar-Toqui

Very shallow to moderately deep, well drained, nearly level to very steep soils; on hillsides, plateaus, and mesas

This map unit is in the western, north-central, and south-central parts of the survey area. The unit is characterized by nearly level to gently sloping plateaus and mesas and strongly sloping to very steep hillsides. Slope is 0 to 75 percent. The vegetation on the Deama soils is juniper, New Mexico feathergrass, black grama, sideoats grama, and turbinella oak. The vegetation on the Tovar soils is juniper, western wheatgrass, blue grama, and black grama. The vegetation on the Toqui soils is pinyon, juniper, blue grama, and big sagebrush. Elevation is 5,200 to 6,800 feet. The average annual precipitation is about 14 to 16 inches, the average annual air temperature is 49 to 54 degrees F, and the average frost-free season is 120 to 170 days.

This unit makes up about 12 percent of the survey area. It is about 70 percent Deama soils, 10 percent Tovar soils, and 8 percent Toqui soils. The remaining 12 percent is components of minor extent.

Deama soils are on hillsides. These soils are very shallow and shallow and are well drained. They formed in alluvium and colluvium derived dominantly from limestone and calcareous sandstone. About 15 to 30 percent of the surface is covered with gravel and stones. The soils are very cobbly and loamy and are underlain by limestone at a depth of 6 to 20 inches.

Tovar soils are on hillsides. These soils are moderately deep and well drained. They formed in alluvium and colluvium derived dominantly from sandstone. From 0 to 30 percent of the surface is covered with stones. The surface layer is loamy. The subsoil is clayey. Unweathered sandstone is at a depth of 20 to 40 inches.

Toqui soils are on plateaus and mesas. These soils are very shallow and shallow and are well drained. They formed in alluvial and eolian deposits derived dominantly from limestone and calcareous sandstone. The surface layer is loamy. The subsoil is clayey. Unweathered limestone is at a depth of 8 to 20 inches.

Of minor extent in this unit are Daze, Disterheff, Kopie, and Rune soils and Rock outcrop.

This unit is used as grazable woodland and for firewood harvesting and wildlife habitat.

The main limitations for most uses are the very shallow and shallow depth to bedrock and very low available water capacity of the Deama and Toqui soils and the slope of the Deama and Tovar soils.

7. Ashfork-Thunderbird-Springerville

Moderately deep and deep, well drained, nearly level to very steep soils; on hillsides and fan terraces and in basins

This map unit is in the southwestern, central, and eastern parts of the survey area. Slope is 0 to 60 percent. The vegetation on the Ashfork soils is mainly blue grama, black grama, galleta, and broom snakeweed. The vegetation on the Thunderbird and Springerville soils is mainly juniper, pinyon, black grama, blue grama, sideoats grama, and vine-mesquite. Elevation is 5,000 to 7,000 feet. The average annual precipitation is about 12 to 16 inches, the average annual air temperature is 49 to 54 degrees F, and the average frost-free season is 130 to 170 days.

This unit makes up about 14 percent of the survey area. It is about 33 percent Ashfork and similar soils, 27 percent Thunderbird soils, and 22 percent Springerville soils. The remaining 18 percent is components of minor extent.

Ashfork soils are on hillsides. These soils are moderately deep and well drained. They formed in pyroclastics and in alluvium and colluvium derived dominantly from basalt. The surface layer is gravelly and loamy. The subsoil is clayey to a depth of 17 inches. Below this, to a depth of 30 inches, the soils are limy, stony, and loamy. Fractured basalt is at a depth of 30 inches.

Thunderbird soils are on hillsides. These soils are moderately deep and well drained. They formed in pyroclastics and in alluvium and colluvium derived dominantly from basalt. About 30 to 50 percent of the surface is covered with cobbles and stones. The soils are clayey and are underlain by basalt at a depth of 20 to 40 inches.

Springerville soils are on fan terraces and in basins. These soils are deep and well drained. They formed in

pyroclastics and in alluvium derived dominantly from basalt. From 30 to 50 percent of the surface is covered with cobbles and stones. The soils are clayey and are underlain by basalt at a depth of 40 to 60 inches.

Of minor extent in this unit are Apache, Aut, Boquillas, Cross, Faraway, Rune, Seligman, Tajo, Wilaha, and Ziegler soils and Rock outcrop.

This unit is used as grazable woodland and rangeland and for firewood harvesting and wildlife habitat.

The main limitations for most uses are depth to bedrock, slope, and the cobbles and stones on the surface of the Thunderbird and Springerville soils.

8. Ziegler-Showlow-Wilaha

Deep, well drained, nearly level to steep soils; on hillsides and fan terraces

This map unit is in the south-central part of the survey area. The unit is characterized by nearly level to strongly sloping fan terraces intermingled with moderately steep to steep hillsides. Slope is 0 to 60 percent. The vegetation on this unit is mainly juniper, pinyon, galleta, blue grama, black grama, winterfat, and needleandthread. Elevation is 5,600 to 7,200 feet. The average annual precipitation is about 12 to 18 inches, the average annual air temperature is 49 to 54 degrees F, and the average frost-free season is 120 to 160 days.

This unit makes up about 4 percent of the survey area. It is about 38 percent Ziegler soils, 30 percent Showlow soils, and 16 percent Wilaha soils. The remaining 16 percent is components of minor extent.

Ziegler soils are on hillsides and fan terraces. These soils are deep and well drained. They formed in pyroclastics and in alluvium derived dominantly from basalt. The surface layer is gravelly and loamy. The subsoil is clayey to a depth of 24 inches and is underlain by cinders that extend to a depth of 60 inches or more.

Showlow soils are on fan terraces and hillsides. These soils are deep and well drained. They formed in mixed alluvium. From 15 to 35 percent of the surface is covered with gravel. The surface layer is gravelly and loamy. The subsoil is gravelly and clayey to a depth of 30 inches. Below this to a depth of 60 inches or more the soils are very gravelly, loamy, and limy.

Wilaha soils are on hillsides and fan terraces. These soils are deep and well drained. They formed in alluvium derived dominantly from basalt and pyroclastics. The soils are cindery and loamy to a depth of 17 inches and are underlain by cinders that extend to a depth of 60 inches or more.

Of minor extent in this unit are Ashfork, Aut, Cross, Quivera, Rune, Thunderbird, Springerville, and Valle soils and Rock outcrop.

This unit is used as grazable woodland and for firewood harvesting and wildlife habitat. The Ziegler and Wilaha soils are a potential source of cinder gravel.

The main limitations for most uses are slope and, in the Wilaha soils, low available water capacity.

detailed soil map units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under "Use and management of the soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil, a brief description of the soil profile, and a listing of the principal hazards and limitations to be considered in planning management.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the underlying material, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the underlying material. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Winona gravelly loam, 0 to 8 percent slopes, is one of several phases in the Winona series.

Some map units are made up of two or more major soils. These map units are called soil complexes or soil associations.

A *soil complex* consists of two or more soils in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Wukoki-Wupatki very cindery loams, 15 to 60 percent slopes, is an example.

A *soil association* is made up of two or more geographically associated soils that are shown as one unit on the maps. Because of present or anticipated soil uses in the survey area, it was not considered practical or necessary to map the soils separately. The pattern and relative proportion of the soils are somewhat similar. Thunderbird-Springerville association, strongly sloping, is an example.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description. Some small areas of strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by a special symbol on the soil maps.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

soil descriptions

1—Ashfork gravelly clay loam, 1 to 15 percent slopes. This moderately deep, well drained soil is on hillsides. It formed in alluvium and colluvium derived dominantly from basalt and pyroclastics. Elevation is 5,000 to 6,800 feet. The average annual precipitation is 12 to 14 inches, the average annual air temperature is 49 to 54 degrees F, and the average frost-free period is 130 to 160 days.

Typically, the surface layer is brown gravelly clay loam 2 inches thick. The upper 5 inches of the subsoil is dark reddish brown clay. The next 5 inches is pale brown clay. The lower 5 inches is light yellowish brown clay loam. The substratum, to a depth of 30 inches, is white stony loam. Fractured basalt is at a depth of 30 inches. Depth to basalt ranges from 20 to 40 inches.

Included in this unit are small areas of Aut gravelly loam on plateaus; Springerville cobbly clay on fan terraces and in basins; and Paymaster, Lynx, and Rune soils on alluvial fans and stream terraces. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

Permeability of this Ashfork soil is slow. Available water capacity is medium. Water supplying capacity is 12 to 14 inches. Effective rooting depth is 20 to 40 inches.

Runoff is slow to medium, and the hazard of water erosion is slight. The hazard of soil blowing is slight.

This unit is used as rangeland and for wildlife habitat.

The potential plant community on this unit is mainly blue grama, galleta, western wheatgrass, and needleandthread. If the range is poorly managed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community.

This unit is suitable for year-round grazing, and it generally provides high yields of forage. Proper grazing use, range seeding, and a planned system of grazing are needed to maintain or improve the production of forage.

The soil in this unit is poorly suited to livestock watering ponds and other water impoundments because of depth to rock and slope. The included Lynx, Rune, and Springerville soils are suited to this use.

Elk and deer use this unit as winter range. The grass cover on the unit provides protection for newborn pronghorn fawns.

If this unit is used for homesite development, the main limitations are shrink-swell potential and depth to bedrock. The effects of shrinking and swelling can be minimized by using proper engineering designs and by backfilling with material that has low shrink-swell potential. Cuts needed to provide essentially level building sites can expose bedrock.

If the unit is used for septic tank absorption fields, the main limitations are slow permeability, depth to bedrock, and slope. Use of long absorption lines and sandy backfill for the trench helps to compensate for the slow permeability. Slope is a concern in installing septic tank absorption fields. Absorption lines should be installed on the contour.

This map unit is in capability subclass VIs.

2—Aut gravelly loam, 0 to 8 percent slopes. This moderately deep, well drained soil is on plateaus and mesas. It formed in alluvium derived dominantly from basalt and limestone. Elevation is 5,400 to 6,500 feet. The average annual precipitation is 12 to 14 inches, the average annual air temperature is 49 to 54 degrees F, and the average frost-free period is 130 to 160 days.

Typically, the surface layer is brown gravelly loam 7 inches thick. Below this, to a depth of 38 inches, is brown, light brownish gray, and very dark gray gravelly and cobbly loam. Fractured basalt is at a depth of 38 inches. Depth to basalt ranges from 20 to 40 inches.

Included in this unit are small areas of Cross very stony clay loam and Ashfork gravelly clay loam in the more sloping areas. Also included are small areas of Paymaster and Lynx soils on alluvial fans and stream terraces. Included areas make up about 15 percent of the total acreage.

Permeability of this Aut soil is moderate. Available water capacity is very low. Water supplying capacity is 12 to 14 inches. Effective rooting depth is 20 to 40 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is slight.

This unit is used as rangeland and for wildlife habitat.

The potential plant community on this unit is mainly winterfat, blue grama, needleandthread, and alkali sacaton. If the range is poorly managed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community.

This unit is suitable for year-round grazing, and it generally provides high yields of forage. Proper grazing use, range seeding, and a planned system of grazing are needed to maintain or improve the production of forage.

The unit is poorly suited to livestock watering ponds and other water impoundments because of the seepage potential, depth to rock, and slope. The included Lynx soils are well suited to this use.

Big game animals and livestock compete for the diverse vegetation and water available on this unit. The grass cover on the unit provides protection for newborn pronghorn fawns.

If this unit is used for homesite development, the main limitation is depth to bedrock. Cuts needed to provide essentially level building sites can expose bedrock. The use of the soil in this unit for septic tank absorption fields is limited by depth to bedrock. Increasing the size of the absorption field helps to compensate for this limitation.

This map unit is in capability subclass VIs.

3—Aut-Cross association, moderately sloping. This map unit is on plateaus and mesas. Slope is 0 to 15 percent. Elevation is 5,400 to 6,600 feet. The average annual precipitation is 12 to 14 inches, the average annual air temperature is 49 to 54 degrees F, and the average frost-free period is 130 to 160 days.

This unit is 60 percent Aut gravelly loam, 0 to 8 percent slopes, and 30 percent Cross very stony clay loam, 8 to 15 percent slopes.

Included in this unit are small areas of Ashfork gravelly clay loam on hillsides, Springerville very stony clay on fan terraces and in basins, and Rock outcrop in strongly sloping areas. Included areas make up about 10 percent of the total acreage. The percentage varies from one area to another.

The Aut soil is moderately deep and well drained. It formed in alluvium derived dominantly from basalt and limestone. Typically, the surface layer is brown gravelly loam 7 inches thick. Below this, to a depth of 38 inches, is light brownish gray gravelly and cobbly loam. Fractured basalt is at a depth of 38 inches. Depth to basalt ranges from 20 to 40 inches.

Permeability of the Aut soil is moderate. Available water capacity is very low. Water supplying capacity is 12 to 14 inches. Effective rooting depth is 20 to 40 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is slight.

The Cross soil is very shallow and shallow and is well drained. It formed in alluvium and colluvium derived dominantly from basalt and pyroclastics. Typically, the surface layer is dark grayish brown very stony clay loam 3 inches thick. The upper 7 inches of the subsoil is dark brown clay loam. The lower 4 inches is pinkish gray clay. The substratum is white, calcareous cobbly clay loam 5 inches thick over basalt. Depth to basalt ranges from 8 to 20 inches.

Permeability of the Cross soil is slow. Available water capacity is very low. Water supplying capacity is 12 to 14 inches. Effective rooting depth is 8 to 20 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is slight.

This unit is used as rangeland and for wildlife habitat.

The potential plant community on the Aut soil is mainly alkali sacaton, winterfat, needleandthread, and blue grama. The potential plant community on the Cross soil is mainly sideoats grama, blue grama, black grama, galleta, and New Mexico feathergrass.

If the range is poorly managed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Mechanical treatment is not practical because of the stones on the surface and steepness of slope of the Cross soil.

This unit is suitable for year-round grazing, and it generally provides high yields of forage. Proper grazing use, range seeding, and a planned system of grazing are needed to maintain or improve the production of forage. The unit is limited for livestock watering ponds and other water impoundments because of depth to bedrock and slope.

Elk and deer use this unit as winter range. Big game animals and livestock compete for the diverse vegetation and water available on the unit. The grass cover provides protection for newborn pronghorn fawns.

If the Aut soil is used for homesite development, the main limitation is depth to bedrock. Cuts needed to provide essentially level building sites can expose bedrock. The use of this soil for septic tank absorption fields is also limited by depth to bedrock. Increasing the size of the absorption field helps to compensate for this limitation.

If the Cross soil is used for homesite development, the main limitations are depth to bedrock and slope. Excavation for buildings and roads is limited by the very shallow and shallow depth to bedrock of the Cross soil. Because removal of the bedrock to an adequate depth could be costly, consider the use of construction methods that do not require excavation. The use of this soil for septic tank absorption fields is limited mainly by depth to bedrock and slope. Consider the use of holding tanks or evaporative beds.

This unit is in capability subclass VIs.

4—Aut-Lynx association, gently sloping. This map unit is on plateaus and alluvial fans. Slope is 0 to 8 percent. Elevation is 5,100 to 6,500 feet. The average annual precipitation is 12 to 14 inches, the average annual air temperature is 49 to 54 degrees F, and the average frost-free period is 130 to 160 days.

This unit is 60 percent Aut gravelly loam and 30 percent Lynx loam. The Aut soil is on plateaus, and the Lynx soil is on alluvial fans.

Included in this unit are small areas of gently sloping Ziegler soils on fan terraces, Cross stony clay loam and Rock outcrop on shoulders of plateaus, and Paymaster and Rune soils on alluvial fans. Included areas make up about 10 percent of the total acreage. The percentage varies from one area to another.

The Aut soil is moderately deep and well drained. It formed in alluvium derived dominantly from basalt and limestone. Typically, the surface layer is brown gravelly loam 7 inches thick. Below this, to a depth of 38 inches, is light brownish gray gravelly and cobbly loam. Fractured basalt is at a depth of 38 inches. Depth to basalt ranges from 20 to 40 inches.

Permeability of the Aut soil is moderate. Available water capacity is very low. Water supplying capacity is 12 to 14 inches. Effective rooting depth is 20 to 40 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is slight.

The Lynx soil is deep and well drained. It formed in alluvium derived from mixed rock sources. Typically, the surface layer is brown loam 2 inches thick. The subsurface layer is brown clay loam 34 inches thick. The underlying material to a depth of 60 inches or more is reddish brown clay loam.

Permeability of the Lynx soil is moderately slow. Available water capacity is high. Water supplying capacity is 12 to 14 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is moderate. The hazard of soil blowing is slight. This soil is subject to rare, brief periods of flooding in winter and spring.

This unit is used as rangeland and for wildlife habitat. The Lynx soil can be used for irrigated crops if water is made available.

The potential plant community on the Aut soil is mainly alkali sacaton, winterfat, needleandthread, and blue grama. If the range is poorly managed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Proper grazing use, range seeding, and a planned system of grazing are needed to maintain or improve the production of forage.

The Aut soil is limited for livestock watering ponds and other water impoundments because of the seepage potential, depth to rock, and slope.

Big game animals and livestock compete for the diverse vegetation and water available on this soil. The

grass cover provides protection for newborn pronghorn fawns.

The potential plant community on the Lynx soil is mainly western wheatgrass, spike muhly, blue grama, and fourwing saltbush. Good accessibility, a large variety of palatable plants, and availability of water encourage a constant grazing pressure.

This soil is suitable for year-round grazing, and it generally provides high yields of forage. Proper grazing use, range seeding, and a planned system of grazing are needed to maintain or improve the production of forage. If the plant cover is disturbed, protection from flooding is needed to control gullying, streambank cutting, and sheet erosion. The soil is suited to the construction of livestock water impoundments.

Use of the Lynx soil by wildlife is restricted mainly to the drainageways, which provide diverse vegetation suitable for food and cover. Elk and deer use the soil as winter range. The quality and quantity of browse on the soil encourage the concentration of big game animals. The grass cover provides protection for newborn pronghorn fawns.

If the Aut soil is used for homesite development, the main limitation is depth to bedrock. Cuts needed to provide essentially level building sites can expose bedrock. The use of this soil for septic tank absorption fields is also limited by depth to bedrock. Increasing the size of the absorption field helps to compensate for this limitation.

If the Lynx soil is used for homesite development, the main limitations are shrink-swell potential and the hazard of flooding. The effects of shrinking and swelling can be minimized by using proper engineering designs and by backfilling with material that has low shrink-swell potential. Dikes and channels that have outlets for floodwater can be used to protect buildings and onsite sewage disposal systems from flooding.

If the Lynx soil is used for septic tank absorption fields, the main limitations are the moderately slow permeability and the hazard of flooding. Use of long absorption lines and sandy backfill for the trench helps to compensate for the moderately slow permeability.

This map unit is in capability subclass VIs.

5—Badland-Torriorthents complex, moderately steep. This map unit is on hillsides and mesas. Slope is 0 to 60 percent. Elevation is 4,200 to 4,800 feet. The average annual precipitation is 6 to 8 inches, the average annual air temperature is 54 to 57 degrees F, and the average frost-free period is 150 to 190 days.

This unit is 55 percent Badland and 25 percent Torriorthents. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of a very gravelly soil on the higher ridgetops; Ives, Navajo, and Tours soils on flood plains; Mespun soils on fan terraces; and gently sloping Epikom soils on plateaus. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

Badland consists of very severely eroded, gently sloping to very steep, almost barren land that is dissected by many intermittent drainageways. It is in an area along the western side of the Little Colorado River, in the northeastern part of the survey area. In the northern part of this area the material is mainly soft shale. This material generally is banded and is multicolored in shades of red and gray. In the southern part of this area the material is red sandy shale and sandstone. Runoff is rapid to very rapid, and the hazard of water erosion is high. The hazard of soil blowing is moderate.

Torriorthents are moderately deep and deep and are well drained. They formed in alluvium and colluvium derived dominantly from sandstone and shale. These soils are highly variable. Generally, 0 to 50 percent of the surface is covered by gravel and a few cobbles. The surface layer is moderately alkaline to strongly alkaline, nonsaline to moderately saline very gravelly loam, gravelly clay loam, or gravelly silt loam 2 to 6 inches thick. The next layer is calcareous and ranges from strongly alkaline gravelly loam to moderately alkaline gravelly clay loam 30 to 40 inches thick. The underlying material is moderately alkaline to strongly alkaline, nonsaline to moderately saline silty clay loam or clay that is underlain by clay stone or soft shale in places.

Permeability of the Torriorthents is variable, ranging from slow to moderate. Available water capacity is low to moderate. Effective rooting depth is 20 to 40 inches. Runoff is rapid to very rapid, and the hazard of water erosion is high. The hazard of soil blowing is moderate.

This unit is used for wildlife habitat. The very gravelly areas on the higher ridgetops are a potential source of sand and gravel.

The present vegetation in most areas is mainly a sparse stand of alkali sacaton, Mormon-tea, shadscale, and broom snakeweed. Most of the vegetation on this unit grows in drainageways because they receive runoff from adjacent areas. Cattle usually avoid areas of this unit unless their movement is restricted by fences.

Use of this unit by wildlife is restricted mainly to the drainageways, which provide diverse vegetation suitable for food and cover.

This unit is poorly suited to homesite development. The main limitations are slope, shrink-swell potential, and depth to bedrock.

Badland is in capability subclass VIIIe, and Torriorthents are in capability subclass VIIe.

6—Boquillas-Seligman complex, 1 to 15 percent slopes. This map unit is on plateaus and mesas. Elevation is 5,800 to 6,300 feet. The average annual precipitation is 14 to 18 inches, the average annual air temperature is 50 to 54 degrees F, and the average frost-free period is 130 to 170 days.

This unit is 50 percent Boquillas gravelly loam and 30 percent Seligman very gravelly clay loam. The

components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Ashfork, Faraway, and Thunderbird soils on hillsides, Springerville soils on fan terraces and in basins, and Lynx and Rune soils on alluvial fans and stream terraces. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

The Boquillas soil is moderately deep and well drained. It formed in alluvium and colluvium derived dominantly from tuff and acid igneous rock. Typically, the upper part of the surface layer is brown gravelly loam 3 inches thick. The lower part is brown clay loam 3 inches thick. The subsoil is dark reddish gray and dark reddish brown gravelly clay about 17 inches thick. The substratum is reddish brown, very gravelly clay loam 15 inches thick. Tuff is at a depth of 38 inches. Depth to tuff ranges from 20 to 40 inches.

Permeability of the Boquillas soil is slow. Available water capacity is low. Water supplying capacity is 14 to 18 inches. Effective rooting depth is 20 to 40 inches. Runoff is slow to medium, and the hazard of water erosion is slight to moderate. The hazard of soil blowing is slight.

The Seligman soil is shallow and well drained. It formed in alluvium and colluvium derived dominantly from tuff and acid igneous rock. Typically, the surface layer is brown very gravelly clay loam 3 inches thick. The subsoil is dark reddish brown clay 12 inches thick. Tuff is at a depth of 15 inches. Depth to tuff ranges from 7 to 20 inches.

Permeability of the Seligman soil is slow. Available water capacity is low. Water supplying capacity is 14 to 18 inches. Effective rooting depth is 7 to 20 inches. Runoff is slow to medium, and the hazard of water erosion is slight to moderate. The hazard of soil blowing is slight.

This unit is used as grazable woodland and for firewood harvesting and wildlife habitat.

The Boquillas soil is well suited to the production of Utah juniper and pinyon. The average site index is 33. The soil can produce 5.5 cords per acre in a stand of trees that average 5 inches in diameter at a height of 1 foot.

The Seligman soil is well suited to the production of Utah juniper and pinyon. The average site index is 91. The soil can produce 13 cords per acre in a stand of trees that average 5 inches in diameter at a height of 1 foot.

Management that minimizes the hazard of erosion is suggested in harvesting firewood on this unit. Disturbed areas can be protected from erosion by seeding adapted plants.

Thinning of dense stands of trees may be desirable where livestock grazing is the main use. Plant competition delays natural regeneration but does not prevent the eventual development of a fully stocked, normal stand of trees.

Pinyon nut production is important for wildlife. Maintenance of snags with more than 40 percent bark is essential for birds that nest in cavities.

The preferred forage plants on the Boquillas soil are blue grama, Mexican cliffrose, antelope bitterbrush, and pinyon ricegrass. The preferred forage plants on the Seligman soil are blue grama, sideoats grama, desert ceanothus, and antelope bitterbrush. This unit has relatively low potential for production of understory forage.

If the understory vegetation is poorly managed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community.

Planned grazing systems are essential to maintain plant vigor and forage production. Where a seed source is lacking in mismanaged areas or where competition from undesirable shrubby plants exists, desirable plants are slow to recover.

If the Boquillas soil is used for homesite development, the main limitations are shrink-swell potential, depth to rock, and slope. The effects of shrinking and swelling can be minimized by using proper engineering designs and by backfilling with material that has low shrink-swell potential. Cuts needed to provide essentially level building sites can expose bedrock.

If this soil is used for septic tank absorption fields, the main limitations are slow permeability, depth to bedrock, and slope. Use of long absorption lines and sandy backfill for the trench helps to compensate for the slow permeability. Slope is a concern in installing septic tank absorption fields. Absorption lines should be installed on the contour.

If the Seligman soil is used for homesite development, the main limitations are depth to bedrock, shrink-swell potential, and slope. Excavation for buildings and roads is limited by shallow depth to bedrock. Because removal of the bedrock to an adequate depth could be costly, consider the use of construction methods that do not require excavation. The effects of shrinking and swelling can be minimized by using proper engineering designs and backfilling with material that has low shrink-swell potential.

If this soil is used for septic tank absorption fields, the main limitations are shallow depth to bedrock and slope. Consider the use of holding tanks or evaporative beds.

This map unit is in capability subclass VIs.

7—Clovis loamy sand, 1 to 8 percent slopes. This deep, well drained, gently rolling soil is on fan terraces. It formed in eolian and alluvial deposits derived dominantly from sandstone, limestone, and quartzite. Elevation is 5,200 to 5,800 feet. The average annual precipitation is 12 to 14 inches, the average annual air temperature is 50 to 54 degrees F, and the average frost-free period is 130 to 175 days.

Typically, the surface layer is reddish brown loamy sand 5 inches thick. The upper 12 inches of the subsoil is red sandy clay loam. The lower 18 inches is yellowish red sandy loam. The substratum to a depth of 60 inches or more is light reddish brown sandy loam.

Included in this unit are small areas of Boysag and Winona soils on plateaus, Poley soils on fan terraces, and Paymaster and Lynx soils on alluvial fans and stream terraces; all of these soils have slopes of as much as 15 percent. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

Permeability of this Clovis soil is moderate. Available water capacity is medium. Water supplying capacity is 11 to 13 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high.

This unit is used as rangeland and for wildlife habitat. It can be used for irrigated crops if water is made available.

The potential plant community on this unit is mainly black grama, Indian ricegrass, blue grama, galleta, and winterfat. If the range is poorly managed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community.

Livestock grazing should be managed to protect the soil from excessive erosion. Seeding suitable plants helps to control blowing and drifting of sand. Proper grazing use, range seeding, and a planned system of grazing are needed to maintain or improve the production of forage.

The soil in this unit is limited for livestock watering ponds and other water impoundments because of the seepage potential.

Elk and deer use this unit as winter range. The grass cover on the unit provides protection for newborn pronghorn fawns. Burrowing animals prefer this unit to most of the other units in the survey area.

This unit is suited to homesite development. The soil in the unit is susceptible to settling if structures are built on it. Settlement can be minimized by compacting the soil.

This map unit is in capability subclass VIs.

8—Cross-Apache complex, 2 to 15 percent slopes. This map unit is on mesas and plateaus. Elevation is 5,200 to 6,200 feet. The average annual precipitation is 12 to 14 inches, the average annual air temperature is 50 to 54 degrees F, and the average frost-free period is 130 to 170 days.

This unit is 50 percent Cross gravelly clay loam and 40 percent Apache cobbly clay loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Ashfork, Cabezon, and Thunderbird soils on hillsides, Springerville soils on fan terraces and in basins, and Rune soils on alluvial fans. Included areas make up about 10 percent of the total acreage. The percentage varies from one area to another.

The Cross soil is very shallow and shallow and is well drained. It formed in alluvium and colluvium derived dominantly from basalt and pyroclastics. Typically, the surface layer is dark grayish brown gravelly clay loam 3 inches thick. The upper 7 inches of the subsoil is dark brown clay. The lower 4 inches is pinkish gray clay. The substratum is white cobbly clay loam 5 inches thick over basalt. Depth to basalt ranges from 8 to 20 inches.

Permeability of the Cross soil is slow. Available water capacity is very low. Water supplying capacity is 11 to 14 inches. Effective rooting depth is 8 to 20 inches. Runoff is slow to medium, and the hazard of water erosion is slight to moderate. The hazard of soil blowing is slight.

The Apache soil is very shallow and shallow and is well drained. It formed in alluvium and colluvium derived dominantly from basalt and pyroclastics. Typically, the surface layer is brown cobbly clay loam 8 inches thick. The underlying material, to a depth of 18 inches, is very pale brown gravelly loam. Basalt is at a depth of 18 inches. Depth to basalt ranges from 6 to 20 inches.

Permeability of the Apache soil is moderate. Available water capacity is very low. Water supplying capacity is 11 to 14 inches. Effective rooting depth is 6 to 20 inches. Runoff is slow to medium, and the hazard of water erosion is slight to moderate. The hazard of soil blowing is slight.

This unit is used as rangeland and for wildlife habitat.

The potential plant community on this unit is mainly blue grama, black grama, sideoats grama, and needleandthread. The production of forage is limited by shallow depth to rock. If the range is poorly managed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Planned grazing systems are essential to maintain plant vigor and forage production.

Management practices suitable for use on this unit are proper range use, deferred grazing, rotation grazing, and aerial spraying for brush management. Where a seed source is lacking in mismanaged areas or where competition from undesirable shrubby plants exists, desirable plants are slow to recover.

This unit is poorly suited to livestock watering ponds and other water impoundments because of depth to bedrock and slope. The included Rune soils are well suited to this use.

Elk and deer use this unit as winter range.

If this unit is used for homesite development, the main limitations are depth to bedrock and slope. Excavation for buildings and roads is limited by very shallow and shallow depth to bedrock. Because removal of the bedrock to an adequate depth could be costly, consider the use of construction methods that do not require excavation.

The use of the unit for septic tank absorption fields is limited by very shallow and shallow depth to bedrock. Consider the use of holding tanks or evaporative beds.

This map unit is in capability subclass VIs.

9—Daze-Deama association, moderately steep. This map unit is on hillsides. Slope is 2 to 30 percent. Elevation is 5,700 to 6,100 feet. The average annual precipitation is 12 to 16 inches, the average annual air temperature is 50 to 54 degrees F, and the average frost-free period is 130 to 170 days.

This unit is 60 percent Daze gravelly loam, 2 to 30 percent slopes, and 30 percent Deama gravelly loam, 15 to 30 percent slopes.

Included in this unit are small areas,of Deama extremely stony loam on backslopes and shoulders, Disterheff and Showlow soils on foot slopes, Paymaster and Lynx soils on alluvial fans, and limestone and calcareous sandstone outcroppings along steep side slopes of narrow drainageways. Included areas make up about 10 percent of the total acreage. The percentage varies from one area to another.

The Daze soil is shallow and well drained. It formed in alluvium and colluvium derived dominantly from cherty, dolomitic limestone and calcareous sandstone. Typically, the surface layer is brown gravelly loam 12 inches thick. The subsoil is reddish brown gravelly clay about 7 inches thick. Fractured cherty, dolomitic limestone is at a depth of 19 inches. Depth to limestone ranges from 10 to 20 inches.

Permeability of the Daze soil is slow. Available water capacity is very low. Water supplying capacity is 11 to 14 inches. Effective rooting depth is 10 to 20 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is slight.

The Deama soil is very shallow and shallow and is well drained. It formed in alluvium and colluvium derived dominantly from limestone and calcareous sandstone. Typically, the surface layer is brown gravelly loam about 7 inches thick. The subsurface layer is brown very cobbly loam about 5 inches thick. The underlying material, to a depth of 19 inches, is light gray very cobbly loam. Limestone is at a depth of 19 inches. Depth to limestone ranges from 6 to 20 inches.

Permeability of the Deama soil is moderate. Available water capacity is very low. Water supplying capacity is 11 to 14 inches. Effective rooting depth is 6 to 20 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is slight.

This unit is used mainly for livestock grazing and wildlife habitat. The Deama soil is suitable for use as woodland.

The potential plant community on the Daze soil is mainly sideoats grama, blue grama, black grama, and needleandthread. The production of forage is limited by steepness of slope, shallow depth to bedrock, and low available water capacity. If the range is poorly managed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community.

Management practices suitable for use on this soil are proper range use, deferred grazing, rotation grazing, and aerial spraying for brush management. Where a seed source is lacking in mismanaged areas or where competition from undesirable shrubby plants exists, desirable plants are slow to recover. Planned grazing systems are essential to maintain plant vigor and forage production.

The Deama soil is well suited to the production of pinyon, Utah juniper, and oneseed juniper. The average site index is 43. The soil can produce 5.5 cords per acre in a stand of trees that average 5 inches in diameter at a height of 1 foot. Management that minimizes the hazard of erosion is essential in harvesting firewood. Disturbed areas can be protected from erosion by seeding adapted plants. Plant competition delays natural regeneration but does not prevent the eventual development of a fully stocked, normal stand of trees.

The preferred forage plants on the Deama soil are blue grama, muttongrass, Mexican cliffrose, and bottlebrush squirreltail. The soil has relatively low potential for production of understory forage. Thinning of dense stands of trees may be desirable where livestock grazing is the main use.

Where a seed source is lacking in mismanaged areas or where competition from undesirable shrubby plants exists, desirable plants are slow to recover on this soil. If the range is poorly managed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community.

This unit is poorly suited to livestock watering ponds and other water impoundments because of shallow depth to bedrock and steepness of slope. The included Lynx soils are suited to this use.

Elk and deer use this unit as winter range.

If this unit is used for homesite development, the main limitations are depth to bedrock and slope. Cuts needed to provide essentially level building sites can expose bedrock. Excavation for buildings and roads is limited by very shallow and shallow depth to bedrock. Because removal of the bedrock to an adequate depth could be costly, consider the use of construction methods that do not require excavation.

If the unit is used for septic tank absorption fields, the main limitations are the very shallow and shallow depth to bedrock and slope. Consider the use of holding tanks or evaporative beds.

This map unit is in capability subclass VIs.

10—Deama gravelly loam, 2 to 15 percent slopes. This very shallow and shallow, well drained, gently sloping to rolling soil is on hillsides. It formed in alluvium

and colluvium derived dominantly from limestone and calcareous sandstone. Elevation is 5,300 to 6,000 feet. The average annual precipitation is 14 to 16 inches, the average annual air temperature is 50 to 54 degrees F, and the average frost-free period is 130 to 170 days.

Typically, the surface layer is brown gravelly loam about 7 inches thick. The subsurface layer is brown very cobbly loam about 5 inches thick. The underlying material, to a depth of 19 inches, is light gray very cobbly loam. Limestone is at a depth of 19 inches. Depth to limestone ranges from 6 to 20 inches.

Included in this unit are small areas of Daze gravelly loam, Deama stony loam, and a soil that is similar to this Deama soil but is noncalcareous. These soils are on backslopes and shoulders. Also included are small areas of Disterheff soils on south-facing foot slopes of fan terraces, Showlow soils on north-facing foot slopes of hillsides, and Rune soils on alluvial fans and stream terraces. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

Permeability of this Deama soil is moderate. Available water capacity is very low. Water supplying capacity is 14 to 16 inches. Effective rooting depth is 6 to 20 inches. Runoff is slow to medium, and the hazard of water erosion is slight to moderate. The hazard of soil blowing is slight.

This unit is used as grazable woodland and for firewood harvesting and wildlife habitat.

This unit is well suited to the production of pinyon, Utah juniper, and oneseed juniper. The average site index is 43. The unit can produce 5.5 cords per acre in a stand of trees that average 5 inches in diameter at a height of 1 foot. Management that minimizes the hazard of erosion is suggested in harvesting firewood. Disturbed areas can be protected from erosion by seeding adapted plants.

The preferred forage plants on this unit are blue grama, muttongrass, Mexican cliffrose, and bottlebrush squirreltail. The unit has relatively low potential for production of understory forage. Thinning of dense stands of trees may be desirable where livestock grazing is the main use. Plant competition delays natural regeneration but does not prevent the eventual development of a fully stocked, normal stand of trees.

If the understory vegetation is poorly managed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Planned grazing systems are essential to maintain plant vigor and forage production. Where a seed source is lacking in mismanaged areas or where competition from undesirable shrubby plants exists, desirable plants are slow to recover.

The unit is poorly suited to livestock watering ponds and other water impoundments because of depth to bedrock and slope. The included Rune soils are suited to this use.

Elk and deer use this unit as winter range. Pinyon nut production is important for wildlife.

If this unit is used for homesite development, the main limitations are depth to bedrock and slope. Cuts needed to provide essentially level building sites can expose bedrock. Excavation for buildings and roads is limited by very shallow and shallow depth to bedrock. Because removal of the bedrock to an adequate depth could be costly, consider the use of construction methods that do not require excavation.

The use of the soil in this unit for septic tank absorption fields is limited by the very shallow and shallow depth to bedrock and slope. Consider the use of holding tanks or evaporative beds.

This map unit is in capability subclass VIs.

11—Deama stony loam, 1 to 15 percent slopes. This very shallow and shallow, well drained, nearly level to rolling soil is on hillsides. It formed in alluvium and colluvium derived dominantly from limestone and calcareous sandstone. Elevation is 5,300 to 6,000 feet. The average annual precipitation is 14 to 16 inches, the average annual air temperature is 50 to 54 degrees F, and the average frost-free period is 130 to 170 days.

Typically, the surface layer is brown stony loam 7 inches thick. The subsurface layer is brown very cobbly loam about 5 inches thick. The underlying material, to a depth of 19 inches, is light gray very cobbly loam. Limestone is at a depth of 19 inches. Depth to limestone ranges from 6 to 20 inches.

Included in this unit are small areas of Daze gravelly loam, Deama gravelly loam, and a soil that is similar to this Deama soil but is noncalcareous; these soils are in gently sloping areas on side slopes. Also included are small areas of Disterheff soils on south-facing foot slopes of fan terraces, Showlow soils on north-facing foot slopes of hillsides, and Rune silty clay loam on alluvial fans and stream terraces. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

Permeability of this Deama soil is moderate. Available water capacity is very low. Water supplying capacity is 11 to 13 inches. Effective rooting depth is 6 to 20 inches. Runoff is slow to medium, and the hazard of water erosion is slight to moderate. The hazard of soil blowing is slight.

This unit is used as grazable woodland and for firewood harvesting and wildlife habitat.

This unit is well suited to the production of pinyon, Utah juniper, and oneseed juniper. The average site index is 43. The unit can produce 5.5 cords per acre in a stand of trees that average 5 inches in diameter at a height of 1 foot. Conventional methods of harvesting timber can be used. Management that minimizes the hazard of erosion is suggested in harvesting firewood. Disturbed areas can be protected from erosion by seeding adapted plants.

The preferred forage plants on this unit are blue grama, muttongrass, Mexican cliffrose, and bottlebrush

squirreltail. The unit has relatively low potential for production of understory forage. Thinning of dense stands of trees may be desirable where livestock grazing is the main use. Plant competition delays natural regeneration but does not prevent the eventual development of a fully stocked, normal stand of trees.

If the understory vegetation is poorly managed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Planned grazing systems are essential to maintain plant vigor and forage production. Where a seed source is lacking in mismanaged areas or where competition from undesirable shrubby plants exists, desirable plants are slow to recover on this unit.

The unit is poorly suited to livestock watering ponds and other water impoundments because of depth to bedrock and slope. The included Rune soils are suited to this use.

Elk and deer use this unit as winter range. Pinyon nut production is important for wildlife.

If this unit is used for homesite development, the main limitations are depth to bedrock and slope. Cuts needed to provide essentially level building sites can expose bedrock. Excavation for buildings and roads is limited by very shallow and shallow depth to bedrock. Because removal of the bedrock to an adequate depth could be costly, consider the use of construction methods that do not require excavation.

If the unit is used for septic tank absorption fields, the main limitations are the very shallow and shallow depth to bedrock and slope. Consider the use of holding tanks or evaporative beds.

This map unit is in capability subclass VIs.

12—Deama-Rock outcrop complex, 8 to 30 percent slopes. This map unit is on hillsides. Elevation is 5,900 to 6,800 feet. The average annual precipitation is 14 to 16 inches, the average annual air temperature is 50 to 54 degrees F, and the average frost-free period is 130 to 170 days.

This unit is 60 percent Deama stony loam and 30 percent Rock outcrop. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Deama gravelly loam, a soil that is similar to this Deama soil but is noncalcareous and is on the tops of hills, Disterheff soils on south-facing foot slopes of fan terraces, Showlow gravelly fine sandy loam on north-facing foot slopes of hillsides, and Rune soils on alluvial fans. Included areas make up about 10 percent of the total acreage. The percentage varies from one area to another.

The Deama soil is very shallow and shallow and is well drained. It formed in alluvium and colluvium derived dominantly from limestone and calcareous sandstone. Typically, the surface layer is brown stony loam 7 inches thick. The subsurface layer is brown very cobbly loam about 5 inches thick. The underlying material, to a depth of 19 inches, is light gray very cobbly loam. Limestone is at a depth of 19 inches. Depth to limestone ranges from 6 to 20 inches.

Permeability of the Deama soil is moderate. Available water capacity is very low. Water supplying capacity is 11 to 13 inches. Effective rooting depth is 6 to 20 inches. Runoff is slow to medium, and the hazard of water erosion is slight to moderate. The hazard of soil blowing is slight.

Rock outcrop consists of exposed areas of limestone and calcareous sandstone.

This unit is used as grazable woodland and for firewood harvesting and wildlife habitat.

The Deama soil is well suited to the production of pinyon, Utah juniper, and oneseed juniper. The average site index is 43. The soil can produce 5.5 cords per acre in a stand of trees that average 5 inches in diameter at a height of 1 foot. Conventional methods of harvesting timber can be used. Management that minimizes the hazard of erosion is suggested in harvesting firewood. Disturbed areas can be protected from erosion by seeding adapted plants.

The preferred forage plants on this soil are blue grama, muttongrass, Mexican cliffrose, and bottlebrush squirreltail. The soil has relatively low potential for production of understory forage. Thinning of dense stands of trees may be desirable where livestock grazing is the main use. Plant competition delays natural regeneration but does not prevent the eventual development of a fully stocked, normal stand of trees.

If the understory vegetation is poorly managed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Planned grazing systems are essential to maintain plant vigor and forage production. Where a seed source is lacking in mismanaged areas and competition from undesirable shrubby plants exists, desirable plants are slow to recover on the Deama soil.

The Deama soil is poorly suited to livestock watering ponds and other water impoundments because of depth to bedrock and slope. The included Rune soils are suited to this use.

Elk and deer use the Deama soil as winter range. Pinyon nut production is important for wildlife. Rock outcrop provides nesting areas for birds of prey.

If the Deama soil is used for homesite development, the main limitations are depth to bedrock and slope. Cuts needed to provide essentially level building sites can expose bedrock. Excavation for buildings and roads is limited by very shallow and shallow depth to bedrock. Because removal of the bedrock to an adequate depth could be costly, consider the use of construction methods that do not require excavation.

The use of the soil for septic tank absorption fields is limited by the very shallow and shallow depth to bedrock

and slope. Consider the use of holding tanks or evaporative beds.

This map unit is in capability subclass VIIs.

13—Deama-Toqui complex, 0 to 8 percent slopes. This map unit is on plateaus and hillsides. Elevation is 5,500 to 6,500 feet. The average annual precipitation is 14 to 16 inches, the average annual air temperature is 49 to 52 degrees F, and the average frost-free period is 120 to 160 days.

This unit is 45 percent Deama gravelly loam and 35 percent Toqui fine sandy loam. The Deama soil is in convex areas, and the Toqui soil is in concave areas.

Included in this unit are small areas of Deama stony loam on ridges; Disterheff soils on foot slopes of fan terraces; Paymaster, Lynx, and Rune soils on alluvial fans and stream terraces; and Kopie soils and Rock outcrop in steep areas adjacent to drainageways. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

The Deama soil is very shallow and shallow and is well drained. It formed in alluvium and colluvium derived dominantly from limestone and calcareous sandstone. Typically, the surface layer is brown gravelly loam 7 inches thick. The subsurface layer is brown very cobbly loam about 5 inches thick. The underlying material, to a depth of 19 inches, is light gray very cobbly loam. Limestone is at a depth of 19 inches. Depth to bedrock ranges from 6 to 20 inches.

Permeability of the Deama soil is moderate. Available water capacity is very low. Water supplying capacity is 14 to 16 inches. Effective rooting depth is 6 to 20 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is slight.

The Toqui soil is very shallow and shallow and is well drained. It formed in alluvial and eolian deposits derived from limestone and calcareous sandstone. Typically, the surface layer is brown fine sandy loam about 1 inch thick. The subsurface layer is light yellowish brown very fine sandy loam about 2 inches thick. The subsoil is reddish brown clay loam and clay 12 inches thick. The substratum is reddish brown very gravelly clay loam 4 inches thick over limestone. Depth to limestone ranges from 8 to 20 inches.

Permeability of the Toqui soil is slow. Available water capacity is very low. Water supplying capacity is 13 to 14 inches. Effective rooting depth is 8 to 20 inches. Runoff is slow, and the hazard of water erosion is moderate. The hazard of soil blowing is slight.

This unit is used as grazable woodland and for firewood harvesting and wildlife habitat.

The Deama soil is well suited to the production of pinyon, Utah juniper, and oneseed juniper. The average site index is 43. The soil can produce 5.5 cords per acre in a stand of trees that average 5 inches in diameter at a height of 1 foot. Management that minimizes the hazard of erosion is suggested in harvesting firewood. Disturbed areas can be protected from erosion by seeding adapted plants.

The preferred forage plants on this soil are blue grama, muttongrass, Mexican cliffrose, and bottlebrush squirreltail. The soil has relatively low potential for production of understory forage. Thinning of dense stands of trees may be desirable where livestock grazing is the main use. Plant competition delays natural regeneration but does not prevent the eventual development of a fully stocked, normal stand of trees.

The Toqui soil is well suited to the production of pinyon, Utah juniper, and oneseed juniper. The average site index is 40. The soil can produce 5 cords per acre in a stand of trees that average 5 inches in diameter at a height of 1 foot. Management that minimizes the hazard of erosion is suggested in harvesting firewood. Disturbed areas can be protected from erosion by seeding adapted plants.

Plant competition delays natural regeneration but does not prevent the eventual development of a fully stocked, normal stand of trees. Brushy plants such as big sagebrush limit natural regeneration of pinyon. To maintain production of wood crops and forage, management may be needed to control big sagebrush.

The preferred forage plants on this soil are blue grama, muttongrass, bottlebrush squirreltail, and Mexican cliffrose. The soil has relatively low potential for production of understory forage.

If the understory vegetation on this unit is poorly managed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Planned grazing systems are essential to maintain plant vigor and forage production. Where a seed source is lacking in mismanaged areas or where competition from undesirable shrubby plants exists, desirable plants are slow to recover on this unit.

The unit is poorly suited to livestock watering ponds and other water impoundments because of depth to bedrock. The included Rune soils are suited to this use.

Elk and deer use this unit as winter range. Pinyon nut production is important for wildlife.

If this unit is used for homesite development, the main limitation is depth to bedrock. Cuts needed to provide essentially level building sites can expose bedrock. Excavation for buildings and roads is limited by very shallow and shallow depth to bedrock. Because removal of the bedrock to an adequate depth could be costly, consider the use of construction methods that do not require excavation.

The use of the unit for septic tank absorption fields is limited by the very shallow and shallow depth to bedrock. Consider the use of holding tanks or evaporative beds.

This map unit is in capability subclass VIs.

14—Deama-Tovar association, steep. This map unit is on hillsides. Slope is 15 to 75 percent. Elevation is 5,800 to 6,300 feet. The average annual precipitation is 14 to 16 inches, the average annual air temperature is 50 to 54 degrees F, and the average frost-free period is 130 to 170 days.

This unit is 50 percent Deama extremely stony loam and 40 percent Tovar extremely stony loam. The Deama soil is in the steeper areas above the Tovar soil, and the Tovar soil is in the less sloping, lower lying areas.

Included in this unit are small areas of Rock outcrop of limestone and sandstone, Disterheff soils, Tovar soils, and Deama gravelly loam. Included areas make up about 10 percent of the total acreage. The percentage varies from one area to another.

The Deama soil is very shallow and shallow and is well drained. It formed in alluvium and colluvium derived dominantly from limestone and calcareous sandstone. Typically, the surface layer is brown extremely stony loam 7 inches thick. The subsurface layer is brown very cobbly loam about 5 inches thick. The underlying material, to a depth of 19 inches, is light gray very cobbly loam. Limestone is at a depth of 19 inches. Depth to limestone ranges from 6 to 20 inches.

Permeability of the Deama soil is moderate. Available water capacity is very low. Water supplying capacity is 13 to 15 inches. Effective rooting depth is 6 to 20 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is slight.

The Tovar soil is moderately deep and well drained. It formed in colluvium derived dominantly from sandstone. Typically, the surface layer is pale brown extremely stony loam 3 inches thick. The upper 5 inches of the subsoil is reddish brown flaggy clay loam. The lower 27 inches is red flaggy clay. Sandstone is at a depth of 35 inches. Depth to sandstone ranges from 20 to 40 inches.

Permeability of the Tovar soil is slow. Available water capacity is medium. Water supplying capacity is 13 to 15 inches. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is slight.

This unit is used mainly for wildlife habitat. It is also used as rangeland.

The potential plant community on the Deama soil is mainly blue grama, sideoats grama, black grama, and needleandthread. The potential plant community on the Tovar soil is mainly sideoats grama, blue grama, western wheatgrass, and muttongrass.

The production of forage on this unit is limited by slope and the stony surface layer. Slope limits access by livestock and results in overgrazing of the less sloping areas. The unit is limited for livestock watering ponds and other water impoundments because of depth to bedrock and slope.

If the Deama soil is used for homesite development, the main limitations are depth to bedrock, slope, and large stones. Cuts needed to provide essentially level building sites can expose bedrock.

The use of the Deama soil for septic tank absorption fields is limited by depth to bedrock, slope, and large stones. Slope is a concern in installing septic tank absorption fields. Absorption lines should be installed on the contour.

If the Tovar soil is used for homesite development, the main limitations are depth to bedrock, slope, and shrink-swell potential. Cuts needed to provide essentially level building sites can expose bedrock. The effects of shrinking and swelling can be minimized by using proper engineering designs and by backfilling with material that has low shrink-swell potential.

The use of the Tovar soil for septic tank absorption fields is limited by depth to bedrock, slow permeability, and slope. Slope is a serious limitation for septic tank absorption fields. Consider the use of holding tanks.

This map unit is in capability subclass VIIs.

15—Disterheff very gravelly sandy clay loam, 1 to 15 percent slopes. This deep, well drained soil is on fan terraces and hillsides. It formed in alluvium and colluvium derived dominantly from pyroclastics, basalt, and quartzite. Elevation is 5,400 to 6,000 feet. The average annual precipitation is 11 to 16 inches, the average annual air temperature is 50 to 54 degrees F, and the average frost-free period is 130 to 170 days.

Typically, the surface layer is brown very gravelly sandy clay loam 2 inches thick. The subsurface layer is brown gravelly clay loam 4 inches thick. The upper 18 inches of the subsoil is dark reddish brown and dark red gravelly clay and clay. The lower 6 inches is red very gravelly clay loam. The substratum to a depth of 60 inches or more is white very cobbly clay loam.

Included in this unit are small areas of Daze gravelly loam and Deama gravelly loam on hillsides; Paymaster, Lynx, and Rune soils on alluvial fans and stream terraces; Showlow soils on north-facing hillsides; and soils, on hillsides, that have slopes of as much as 25 percent. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

Permeability of this Disterheff soil is slow. Available water capacity is high. Water supplying capacity is 14 to 16 inches. Effective rooting depth is 40 to 60 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is slight.

This unit is used as rangeland and for wildlife habitat.

The potential plant community on this unit is mainly galleta, black grama, western wheatgrass, blue grama, and sideoats grama. If the range is poorly managed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Planned grazing systems are essential to maintain plant vigor and forage production.

The more steeply sloping areas of this unit are poorly suited to livestock watering ponds and other water

impoundments. The less steeply sloping areas and the included Lynx and Rune soils are suited to this use.

Elk and deer use this unit as winter range. The grass cover on the unit provides protection for newborn pronghorn fawns.

If this unit is used for homesite development, the main limitations are shrink-swell potential and slope. If buildings are constructed on the soil in this unit, properly designing foundations and footings and diverting runoff away from buildings help to prevent structural damage because of shrinking and swelling.

If the soil in this unit is used for septic tank absorption fields, the main limitations are slow permeability and slope. The limitation of slow permeability can be overcome by increasing the size of the absorption field. Slope is a concern in installing septic tank absorption fields. Absorption lines should be installed on the contour.

This map unit is in capability subclass VIs.

16—Disterheff-Kopie association, moderately sloping. This map unit is on dissected fan terraces and plateaus. It is in long, narrow, irregularly shaped areas below and adjacent to steep slopes surrounding basalt mesas. Slope is 0 to 15 percent. Elevation is 5,000 to 6,000 feet. The average annual precipitation is 12 to 14 inches, the average annual air temperature is 50 to 54 degrees F, and the average frost-free period is 130 to 170 days.

This unit is 60 percent Disterheff cobbly loam, 0 to 8 percent slopes, and 30 percent Kopie gravelly fine sandy loam, 8 to 15 percent slopes. The Disterheff soil is on fan terraces, and the Kopie soil is on plateaus.

Included in this unit are small areas of moderately steep Purgatory soils, Rune silty clay loam on alluvial fans, Ives sandy loam on the upper part of alluvial fans, and Rock outcrop of sandstone. Included areas make up about 10 percent of the total acreage. The percentage varies from one area to another.

The Disterheff soil is deep and well drained. It formed in alluvium and colluvium derived dominantly from pyroclastics, quartzite, and basalt. Typically, the surface layer is brown cobbly loam 2 inches thick. The subsurface layer is brown gravelly clay loam about 4 inches thick. The upper 18 inches of the subsoil is dark red gravelly clay and clay. The lower 6 inches is red very gravelly clay loam. The substratum to a depth of 60 inches or more is white very cobbly clay loam.

Permeability of the Disterheff soil is slow. Available water capacity is high. Water supplying capacity is 12 to 14 inches. Effective rooting depth is 40 to 60 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is slight.

The Kopie soil is shallow and well drained. It formed in alluvial and eolian deposits derived dominantly from calcareous sandstone and sandy shale. Typically, the surface layer is reddish brown gravelly fine sandy loam 3 inches thick. The subsoil, to a depth of 15 inches, is reddish yellow gravelly loam. Fractured, thin-bedded, sandy shale is at a depth of 15 inches. Depth to sandy shale ranges from 10 to 20 inches.

Permeability of the Kopie soil is moderate. Available water capacity is very low. Water supplying capacity is 11 to 13 inches. Effective rooting depth is 10 to 20 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is slight.

This unit is used as rangeland and for wildlife habitat.

The potential plant community on the Disterheff soil is mainly western wheatgrass, galleta, black grama, sideoats grama, and blue grama. If the range is poorly managed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community.

Mechanical treatment is not practical on this soil, because the surface is stony. Suitable range management practices are fencing, implementing planned grazing systems, and developing water for livestock. Planned grazing systems are essential to maintain plant vigor and forage production.

The more steeply sloping areas of the Disterheff soil are poorly suited to livestock watering ponds and other water impoundments. The less sloping areas and the included Rune soil are suited to this use.

The potential plant community on the Kopie soil is mainly black grama, Indian ricegrass, New Mexico feathergrass, and fourwing saltbush. The production of forage is limited by depth to bedrock and low available water capacity.

The Kopie soil is poorly suited to livestock watering ponds and other water impoundments because of depth to bedrock and slope. The included Rune soil is suited to this use.

Elk and deer use this unit as winter range. The grass cover on the unit provides protection for newborn pronghorn fawns.

If the Disterheff soil is used for homesite development, the main limitations are shrink-swell potential and slope. If buildings are constructed on this soil, properly designing foundations and footings and diverting runoff away from buildings help to prevent structural damage because of shrinking and swelling.

If this soil is used for septic tank absorption fields, the main limitations are slow permeability and slope. Use of sandy backfill for the trench and long absorption lines helps to compensate for the slow permeability. Slope is a concern in installing septic tank absorption fields. Absorption lines should be installed on the contour.

If the Kopie soil is used for homesite development, the main limitations are depth to bedrock and slope. Excavation for buildings and roads is limited by shallow depth to bedrock. Because removal of the bedrock to an adequate depth could be costly, consider the use of construction methods that do not require excavation.

If this soil is used for septic tank absorption fields, the main limitations are the shallow depth to bedrock and

slope. Consider the use of holding tanks or evaporative beds.

This map unit is in capability subclass VIs.

17—Epikom very cindery loamy sand, 0 to 5 percent slopes. This shallow, well drained soil is on plateaus and mesas. It formed in alluvial and eolian deposits derived dominantly from calcareous sandstone and sandy shale and from pyroclastics. Elevation is 5,000 to 5,500 feet. The average annual precipitation is 6 to 10 inches, the average annual air temperature is 52 to 55 degrees F, and the average frost-free period is 150 to 175 days.

Typically, the surface layer is dark reddish brown very cindery loamy sand 8 inches thick. Below this to a depth of 13 inches is reddish brown loam. Calcareous sandstone is at a depth of 13 inches. Depth to sandstone ranges from 10 to 20 inches.

Included in this unit are small areas of other Epikom soils and Rock outcrop in gently sloping areas and Wukoki soils in concave areas and on the edge of plateaus. Included areas make up about 25 percent of the total acreage. The percentage varies from one area to another.

Permeability of this Epikom soil is moderate. Available water capacity is very low. Water supplying capacity is 6 to 8 inches. Effective rooting depth is 10 to 20 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is slight.

This unit is used as rangeland and for wildlife habitat.

The potential plant community on this unit is mainly galleta, black grama, alkali sacaton, fourwing saltbush, and blue grama. The production of forage is limited by shallow depth to bedrock and the very low available water capacity. If the range is poorly managed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community.

Livestock grazing should also be managed to protect the unit from excessive erosion. Suitable range management practices are fencing, implementing planned grazing systems, and developing water for livestock. Where a seed source is lacking in mismanaged areas or where competition from undesirable shrubby plants exists, desirable plants are slow to recover on this unit.

The unit is limited for livestock watering ponds and other water impoundments because of depth to bedrock.

Elk and deer use this unit as winter range. The grass cover on this unit provides protection for newborn pronghorn fawns.

If this unit is used for homesite development, the main limitation is shallow depth to bedrock. Cuts needed to provide essentially level building sites can expose bedrock. Excavation for buildings and roads is limited by the shallow depth to bedrock. Because removal of the bedrock to an adequate depth could be costly, consider the use of construction methods that do not require excavation.

The use of the unit for septic tank absorption fields is limited by shallow depth to bedrock. Consider the use of holding tanks or evaporative beds.

This map unit is in capability subclass VIIs.

18—Epikom complex, 0 to 15 percent slopes. This map unit is on broad plateaus and mesas (fig. 1). Elevation is 4,800 to 5,600 feet. The average annual precipitation is 6 to 10 inches, the average annual air temperature is 52 to 55 degrees F, and the average frost-free period is 150 to 175 days.

This unit is 50 percent Epikom fine sandy loam and 40 percent Epikom gravelly fine sandy loam. The Epikom fine sandy loam is in concave areas. Slope ranges from 0 to 8 percent but is mainly 2 to 5 percent. The Epikom gravelly fine sandy loam is on ridges. Slope is 8 to 15 percent.

Included in this unit are small areas of Tours silty clay loam in recent alluvial swales, Ives sandy loam on alluvial fans, and Rock outcrop of sandstone. Included areas make up about 10 percent of the total acreage. The percentage varies from one area to another.

The Epikom fine sandy loam is shallow and well drained. It formed in alluvial and eolian deposits derived dominantly from calcareous sandstone and shale. Typically, the surface layer is reddish brown fine sandy loam 3 inches thick. The subsoil, to a depth of 15 inches, is reddish yellow gravelly loam. Fractured sandstone is at a depth of 15 inches. Depth to bedrock ranges from 10 to 20 inches.

The Epikom gravelly fine sandy loam is shallow and well drained. It formed in alluvial and eolian deposits derived dominantly from calcareous sandstone and shale. Typically, the surface layer is reddish brown gravelly fine sandy loam 3 inches thick. The subsoil, to a depth of 15 inches, is reddish yellow gravelly loam. Fractured, thin-bedded, sandy shale is at a depth of 15 inches. Depth to sandy shale ranges from 10 to 20 inches.

Permeability of the Epikom soils is moderate. Available water capacity is very low. Water supplying capacity is 5 to 9 inches. Effective rooting depth is 10 to 20 inches. Runoff is slow, and the hazard of water erosion is slight to moderate. The hazard of soil blowing is high.

This unit is used as rangeland and for wildlife habitat.

The potential plant community on this unit is mainly galleta, black grama, blue grama, alkali sacaton, and fourwing saltbush. The production of forage is limited by shallow depth to bedrock and very low available water capacity.

If the range is poorly managed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore,

Figure 1.—Area of Epikom complex, 0 to 15 percent slopes.

livestock grazing should be managed so that the desired balance of species is maintained in the plant community. This balance of vegetation reduces the hazard of soil blowing.

Suitable range management practices are fencing, implementing planned grazing systems, and developing water for livestock. Where a seed source is lacking in mismanaged areas or where competition from undesirable shrubby plants exists, desirable plants are slow to recover on this unit.

The unit is limited for livestock watering ponds and other water impoundments because of depth to bedrock and slope.

Elk and deer use this unit as winter range. The grass cover on the unit provides protection for newborn pronghorn fawns.

If this unit is used for homesite development, the main limitation is depth to bedrock. Cuts needed to provide essentially level building sites can expose bedrock. Excavation for buildings and roads is limited by shallow depth to bedrock. Because removal of the bedrock to an adequate depth could be costly, consider the use of construction methods that do not require excavation.

The use of the unit for septic tank absorption fields is limited by the shallow depth to bedrock. Consider the use of holding tanks or evaporative beds.

This map unit is in capability subclass VIIs.

19—Epikom-Rock outcrop complex, 8 to 60 percent slopes. This map unit is on plateaus intermingled with mesas, buttes, and escarpments. Elevation is 4,500 to 5,300 feet. The average annual precipitation is 6 to 10 inches, the average annual air temperature is 52 to 55 degrees F, and the average frost-free period is 150 to 175 days.

This unit is 70 percent Epikom gravelly fine sandy loam and 20 percent Rock outcrop. The Epikom soil is on the tops and foot slopes of mesas and buttes. It has slopes of 8 to 15 percent. Rock outcrop is on the sides of mesas, buttes, and escarpments. It commonly has slopes of 15 to 60 percent. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Tours silty clay loam and Ives sandy loam on alluvial fans. Also included are small areas of Epikom fine sandy loam and stony alluvial and colluvial material on very steep slopes below escarpments. Included areas make up about 10 percent of the total acreage. The percentage varies from one area to another.

The Epikom soil is shallow and is well drained. It formed in alluvial and eolian deposits derived dominantly from calcareous sandstone and shale. Typically, the surface layer is reddish brown gravelly fine sandy loam 3 inches thick. The subsoil, to a depth of 15 inches, is

yellowish red gravelly loam. Fractured, thin-bedded, sandy shale is at a depth of 15 inches. Depth to sandy shale ranges from 10 to 20 inches. In some areas the surface layer is sandy loam or fine sandy loam.

Permeability of the Epikom soil is moderate. Available water capacity is very low. Water supplying capacity is 4 to 7 inches. Effective rooting depth is 10 to 20 inches. Runoff is medium to rapid, and the hazard of water erosion is slight to moderate. The hazard of soil blowing is high.

Rock outcrop consists of exposed areas of sandstone. Generally, the rock is very hard and requires blasting for removal.

This unit is used as rangeland and for wildlife habitat.

The potential plant community on the Epikom soil is mainly galleta, black grama, blue grama, alkali sacaton, and fourwing saltbush. The production of forage is limited by shallow depth to bedrock, steepness of slope, and very low available water capacity.

If the range is poorly managed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. This balance of vegetation reduces the hazard of soil blowing. Where a seed source is lacking in mismanaged areas or where competition from undesirable shrubby plants exists, desirable plants are slow to recover.

Suitable range management practices are fencing, implementing planned grazing systems, and developing water for livestock. Trails or walkways can be constructed in places to encourage livestock to graze in areas where access is limited. Mechanical treatment is limited because of the areas of Rock outcrop and steepness of slope.

The Epikom soil is limited for livestock watering ponds and other water impoundments because of depth to bedrock and slope.

The quality and quantity of browse on the Epikom soil encourage the concentration of big game animals. Big game animals and livestock compete for food and cover in winter. Rock outcrop provides nesting areas for birds of prey.

If this unit is used for homesite development, the main limitations are depth to bedrock, slope, and Rock outcrop. Cuts needed to provide essentially level building sites can expose bedrock. Excavation for buildings and roads is limited by the shallow depth to bedrock. Because removal of the bedrock to an adequate depth could be costly, consider the use of construction methods that do not require excavation.

The use of the soil in this unit for septic tank absorption fields is limited by the shallow depth to bedrock and slope. Consider the use of holding tanks or evaporative beds.

This map unit is in capability subclass VIIs.

20—Faraway-Rock outcrop complex, 20 to 80 percent slopes. This map unit is on hillsides. Elevation is 6,000 to 7,400 feet. The average annual precipitation is 14 to 18 inches, the average annual air temperature is 50 to 54 degrees F, and the average frost-free period is 120 to 160 days.

This unit is 60 percent Faraway very gravelly loam and 30 percent Rock outcrop. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Boquillas and Seligman soils on broad ridges, Springerville soils in basins, and Cabezon and moderately steep Thunderbird soils on hillsides. Included areas make up about 10 percent of the total acreage.

The Faraway soil is very shallow and shallow and is well drained. It formed in alluvium and colluvium derived dominantly from rhyodacite and andesite. The surface layer is grayish brown or dark grayish brown very gravelly loam 7 inches thick. The subsoil is brown very gravelly loam about 6 inches thick. Rhyodacite is at a depth of 13 inches. Depth to rhyodacite ranges from 5 to 20 inches.

Permeability of the Faraway soil is moderate. Available water capacity is very low. Water supplying capacity is 10 to 14 inches. Effective rooting depth is 5 to 20 inches. Runoff is medium to rapid, and the hazard of water erosion is moderate to high. The hazard of soil blowing is slight.

Rock outcrop consists of exposed areas of rhyodacite and andesite.

This unit is used as rangeland and for wildlife habitat.

The potential plant community on the Faraway soil is mainly blue grama, black grama, sideoats grama, needleandthread, and juniper. The production of forage is limited by steepness of slope, shallow soil depth, and low available water capacity. Where a seed source is lacking in mismanaged areas or where competition from undesirable shrubby plants exists, desirable plants are slow to recover.

Trails or walkways can be constructed in places to encourage livestock to graze in areas where access is limited. Mechanical treatment is not practical because of the areas of Rock outcrop and the steepness of slope.

The quality and quantity of browse on the Faraway soil encourage the concentration of big game animals. Big game animals and livestock compete for food and cover in winter. Rock outcrop provides nesting areas for birds of prey.

The Faraway soil is limited for livestock watering ponds and other water impoundments because of depth to bedrock and slope.

If this unit is used for homesite development, the main limitations are steepness of slope and depth to bedrock. Cuts needed to provide essentially level building sites can expose bedrock. Excavation for buildings and roads is limited by very shallow and shallow depth to bedrock. Because removal of the bedrock to an adequate depth could be costly, consider the use of construction methods that do not require excavation.

If the soil in this unit is used for septic tank absorption fields, the main limitations are very shallow and shallow depth to bedrock and slope. Consider the use of holding tanks or evaporative beds.

This map unit is in capability subclass VIIs.

21—Keeseha-Poley gravelly sandy loams, 0 to 8 percent slopes. This map unit is on fan terraces. Elevation is 5,400 to 6,000 feet. The average annual precipitation is 12 to 14 inches, the average annual air temperature is 52 to 54 degrees F, and the average frost-free period is 140 to 175 days.

This unit is 60 percent Keeseha gravelly sandy loam and 30 percent Poley gravelly sandy loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Clovis and Palma soils on the sides of fan terraces, Deama and Pastura soils on the tops of fan terraces and on hillsides, and Lynx and Rune soils on alluvial fans. Included areas make up about 10 percent of the total acreage. The percentage varies from one area to another.

The Keeseha soil is deep and well drained. It formed in alluvium derived dominantly from sandstone, limestone, shale, and quartzite. Typically, the surface layer is brown gravelly sandy loam 2 inches thick. The subsurface layer is brown sandy clay loam 2 inches thick. The subsoil is yellowish red clay 9 inches thick. The upper 7 inches of the substratum is yellowish red gravelly sandy clay loam. The lower part to a depth of 60 inches or more is pinkish white very gravelly sandy loam.

Permeability of the Keeseha soil is slow to a depth of 13 inches and moderately slow to moderate below this depth. Available water capacity is medium. Water supplying capacity is 12 to 14 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high.

The Poley soil is deep and well drained. It formed in alluvium derived dominantly from sandstone, limestone, shale, and quartzite. Typically, the surface layer is brown gravelly sandy loam 4 inches thick. The upper 6 inches of the subsoil is yellowish red clay loam. The lower 12 inches is yellowish red clay. The upper 18 inches of the substratum is pink gravelly sandy clay loam. The lower part to a depth of 60 inches or more is yellowish red very gravelly sandy loam.

Permeability of the Poley soil is slow to a depth of 22 inches and moderate below this depth. Available water capacity is high. Water supplying capacity is 12 to 14 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

This unit is used as rangeland and for wildlife habitat.

The potential plant community on this unit is mainly blue grama, black grama, needleandthread, and Indian ricegrass. If the range is poorly managed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Livestock grazing should be managed to protect the unit from excessive erosion.

This unit is suitable for year-round grazing, and it generally provides high yields of forage. Proper grazing use, range seeding, and a planned system of grazing are needed to maintain or improve the production of forage. This unit responds more readily to proper management than do most of the other units in the survey area.

This unit is poorly suited to livestock watering ponds and other water impoundments because of seepage potential. The included Lynx and Rune soils are suited to this use.

Elk and deer use this unit as winter range. The grass cover on the unit provides protection for newborn pronghorn fawns. Burrowing animals prefer this unit to most of the other units in the survey area.

This unit is suited to homesite development.

The use of the Poley soil for septic tank absorption fields is limited by slow permeability. Absorption lines should be placed below the slowly permeable layer.

This map unit is in capability subclass VIs.

22—Kopie-Servilleta association, moderately sloping. This map unit is on plateaus. Slope is 1 to 15 percent. Elevation is 5,400 to 6,000 feet. The average annual precipitation is 12 to 14 inches, the average annual air temperature is 49 to 54 degrees F, and the average frost-free period is 130 to 160 days.

This unit is 60 percent Kopie gravelly fine sandy loam and 30 percent Servilleta fine sandy loam. The Kopie soil is in convex areas and has slopes of 2 to 15 percent. The Servilleta soil is in depressional areas and has slopes that range from 1 to 8 percent but are dominantly 1 to 3 percent.

Included in this unit are small areas of Rune soils on alluvial fans, gently sloping Tusayan soils on side slopes, Rock outcrop in strongly sloping areas, and a soil that is similar to the Kopie soil but has a layer of carbonate accumulation above the bedrock. Included areas make up about 10 percent of the total acreage. The percentage varies from one area to another.

The Kopie soil is shallow and well drained. It formed in eolian deposits underlain by alluvium derived dominantly from calcareous sandy shale and sandstone. Typically, the surface layer is yellowish red gravelly fine sandy loam 2 inches thick. The subsurface layer is reddish brown loam 4 inches thick. The subsoil is light reddish brown channery loam 8 inches thick. Fractured, calcareous sandstone is at a depth of 14 inches. Depth to sandstone ranges from 10 to 20 inches.

Permeability of the Kopie soil is moderate. Available water capacity is very low. Water supplying capacity is 11 to 13 inches. Effective rooting depth is 6 to 20 inches. Runoff is medium, and the hazard of water erosion is slight. The hazard of soil blowing is slight.

The Servilleta soil is moderately deep and well drained. It formed in alluvium derived dominantly from shale, sandstone, and quartzite. Typically, the surface layer is light reddish brown fine sandy loam 2 inches thick. The upper 4 inches of the subsoil is reddish brown clay loam. The lower 11 inches is reddish brown clay. The substratum is pink clay loam and gravelly clay loam 17 inches thick over fractured shale. Depth to shale ranges from 20 to 40 inches.

Permeability of the Servilleta soil is slow. Available water capacity is medium. Water supplying capacity is 11 to 13 inches. Effective rooting depth is 20 to 40 inches. Runoff is slow to medium, and the hazard of water erosion is high. The hazard of soil blowing is high.

This unit is used mainly for livestock grazing and wildlife habitat. The Kopie soil is also used as woodland.

The Kopie soil is poorly suited to the production of oneseed juniper and pinyon. The average site index is 11. The soil can produce 1 cord per acre in a stand of trees that average 5 inches in diameter at a height of 1 foot. Management that minimizes the hazard of erosion is suggested in harvesting firewood. Disturbed areas can be protected from erosion by seeding adapted plants. Plant competition delays natural regeneration but does not prevent the eventual development of a fully stocked, normal stand of trees.

Maintenance of snags with more than 40 percent bark is essential for birds that nest in cavities. Pinyon nut production is important for wildlife.

The preferred forage plants on the Kopie soil are Indian ricegrass, black grama, New Mexico feathergrass, and fourwing saltbush. The soil has relatively high potential for production of understory forage.

The potential plant community on the Servilleta soil is mainly blue grama, galleta, western wheatgrass, and fourwing saltbush. If the range is poorly managed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community.

Planned grazing systems are essential to maintain plant vigor and forage production. Where a seed source is lacking in mismanaged areas or where competition from undesirable shrubby plants exists, desirable plants are slow to recover on this soil. Suitable range management practices are fencing, implementing planned grazing systems, and developing water for livestock.

The unit is poorly suited to livestock watering ponds and other water impoundments because of depth to bedrock and slope. The included Rune soils are suited to this use.

Elk and deer use this unit as winter range. The grass cover on the unit provides protection for newborn pronghorn fawns.

If the Kopie soil is used for homesite development, the main limitations are shallow depth to bedrock and slope. Excavation for buildings and roads is limited by shallow depth to bedrock. Because removal of the bedrock to an adequate depth could be costly, consider the use of construction methods that do not require excavation.

The use of this soil for septic tank absorption fields is limited by the shallow depth to bedrock. Consider the use of holding tanks or evaporative beds.

If the Servilleta soil is used for homesite development, the main limitations are shrink-swell potential and depth to bedrock. The effects of shrinking and swelling can be minimized by using proper engineering designs and by backfilling with material that has low shrink-swell potential. Cuts needed to provide essentially level building sites can expose bedrock.

The use of this soil for septic tank absorption fields is limited mainly by slow permeability and depth to bedrock. Use of long absorption lines and sandy backfill for the trench helps to compensate for the slow permeability.

This map unit is in capability subclass VIs.

23—Lava flows. Lava flows is an area covered with geologically recent basalt lava. It has the sharp and jagged surfaces, crevices, and angular blocks that are characteristic of lava. A little soil material is in a few cracks and sheltered pockets, but the flow is virtually devoid of plant life except for lichens. The average annual precipitation is 8 to 14 inches, the average annual air temperature is 52 to 55 degrees F, and the average frost-free period is 150 to 175 days.

This unit is used for wildlife habitat.

The many caves and crevices in areas of Lava flows provide daytime protection for owls and bats. Bobcat, skunk, coyote, and badger also make use of the abundant shelter in the flows.

This map unit is in capability subclass VIIIs.

24—Lomaki-Nalaki very cindery loams, 0 to 8 percent slopes. This map unit is on fan terraces. Elevation is 4,800 to 5,900 feet. The average annual precipitation is 8 to 14 inches, the average annual air temperature is 52 to 55 degrees F, and the average frost-free period is 150 to 175 days.

This unit is 60 percent Lomaki very cindery loam and 30 percent Nalaki very cindery loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of gently sloping Tuweep soils on plateaus, nearly level Wukoki and Wupatki soils on fan terraces, and Rock outcrop. Included areas make up about 10 percent of the total acreage. The percentage varies from one area to another.

The Lomaki soil is deep and well drained. It formed in alluvium derived dominantly from pyroclastics. Typically, the surface layer is brown very cindery loam 3 inches thick. The subsurface layer is grayish brown very cindery loam 5 inches thick. The upper 6 inches of the subsoil is light yellowish brown very cindery loam. The lower 10

inches is pale brown extremely cindery loam. The substratum to a depth of 60 inches or more is cinders.

Permeability of the Lomaki soil is moderate. Available water capacity is low. Water supplying capacity is 8 to 14 inches. Effective rooting depth is 40 to 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is slight.

The Nalaki soil is moderately deep and well drained. It formed in alluvium derived dominantly from pyroclastics. Typically, the surface layer is brown very cindery loam 3 inches thick. The subsurface layer is brown very cindery loam 7 inches thick. The subsoil is pale brown and light yellowish brown, calcareous extremely cindery loam 11 inches thick. The next layer is a pinkish white, silica- and lime-cemented cindery hardpan 6 inches thick. The substratum to a depth of 60 inches or more is cinders.

Permeability of the Nalaki soil is moderate. Available water capacity is very low. Water supplying capacity is 8 to 14 inches. Effective rooting depth is 20 to 40 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is slight.

This unit is used as rangeland and for wildlife habitat.

The potential plant community on this unit is mainly black grama, blue grama, sideoats grama, and galleta. If the range is poorly managed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Proper grazing use, range seeding, and a planned system of grazing are needed to maintain or improve the production of forage.

The unit is limited for livestock watering ponds and other water impoundments because of seepage potential.

Elk and deer use this unit as winter range. The grass cover on the unit provides protection for newborn pronghorn fawns. Rock outcrop provides nesting areas for birds of prey.

The Lomaki soil is well suited to homesite development. It commonly is susceptible to settling if structures are built on it. Settlement can be minimized by compacting the soil.

If the Nalaki soil is used for homesite development, the main limitation is the depth to the cemented pan. In addition, the soil is susceptible to settling if structures are built on it. Settlement can be minimized by compacting the soil. The hardpan is rippable and therefore is not a serious limitation for most engineering uses.

The use of the soils in this unit for septic tank absorption fields is limited by poor filtration of the cinders and the hazard of ground water contamination. The Nalaki soil is also limited by the depth to the cemented pan. This limitation can be overcome by ripping the pan to increase permeability.

This map unit is in capability subclass VIs.

25—Mespun-Palma complex, 1 to 8 percent slopes. This map unit is in nearly level to gently rolling and slightly undulating areas on fan terraces. Elevation is 5,200 to 5,300 feet. The average annual precipitation is 12 to 14 inches, the average annual air temperature is 52 to 54 degrees F, and the average frost-free period is 140 to 175 days.

This unit is 50 percent Mespun loamy sand and 30 percent Palma sandy loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of nearly level Clovis, Keeseha, and Poley soils on the tops of fan terraces and Rune soils on alluvial fans. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

The Mespun soil is deep and excessively drained. It formed in water-reworked eolian deposits derived dominantly from sandstone, shale, and quartzite. Typically, the surface layer is brown loamy sand about 4 inches thick. The underlying material is reddish brown and reddish yellow loamy sand that extends to a depth of 60 inches or more.

Permeability of the Mespun soil is rapid. Available water capacity is low. Water supplying capacity is 11 to 13 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high.

The Palma soil is deep and well drained. It formed in wind-reworked alluvium derived from mixed sources. Typically, the surface layer is brown sandy loam 6 inches thick. The subsoil is yellowish red sandy loam 26 inches thick. The substratum to a depth of 60 inches or more is yellowish red, calcareous sandy loam.

Permeability of the Palma soil is moderately rapid. Available water capacity is medium. Water supplying capacity is 11 to 13 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high.

This unit is used as rangeland and for wildlife habitat.

The potential plant community on this unit is mainly Indian ricegrass, blue grama, galleta, and needleandthread. If the range is poorly managed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Livestock grazing should also be managed to protect the unit from excessive erosion.

Proper grazing use, range seeding, and a planned system of grazing are needed to maintain or improve the production of forage. Seeding suitable plants helps to control blowing and drifting of sand. This unit responds more readily to proper management than do most of the other units in the survey area.

The unit is poorly suited to livestock watering ponds and other water impoundments because of the seepage potential. The included Rune soils are well suited to this use.

Elk and deer use this unit as winter range. The grass cover on the unit provides protection for newborn pronghorn fawns. Burrowing animals prefer this unit to most of the other units in the survey area.

This unit is well suited to homesite development. The soils in the unit are susceptible to settling if structures are built on them. Settlement can be minimized by compacting the soils.

This map unit is in capability subclass VIe.

26—Navajo clay, 0 to 5 percent slopes. This deep, well drained soil is on flood plains and in basins. It formed in alluvium derived from mixed sources. Elevation is 4,900 to 5,600 feet. The average annual precipitation is 6 to 10 inches, the average annual air temperature is 52 to 55 degrees F, and the average frost-free period is 140 to 175 days.

Typically, the surface layer is reddish brown clay 14 inches thick. The underlying material to a depth of 60 inches or more is reddish brown clay.

Included in this unit are small areas of Ives sandy loam, Tours silty clay loam, and Tours fine sandy loam on alluvial fans on the edge of areas of this unit and Navajo soils in basins. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

Permeability of this Navajo soil is very slow. Available water capacity is high. Water supplying capacity is 6 to 10 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is moderate. This soil is subject to rare, brief periods of flooding in winter and spring.

This unit is used as rangeland and for wildlife habitat. It can be used for irrigated crops if water is made available.

The potential plant community on this unit is mainly alkali sacaton, blue grama, western wheatgrass, galleta, and fourwing saltbush. If the range is poorly managed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Good accessibility, a large variety of palatable plants, and availability of water encourage a constant grazing pressure.

If the plant cover is disturbed, protection from flooding is needed to control gullying, streambank cutting, and sheet erosion. Proper grazing use, range seeding, and a planned system of grazing are needed to maintain or improve the production of forage.

This unit is suited to the construction of livestock water impoundments.

Use of this unit by wildlife is restricted mainly to the drainageways, which provide diverse vegetation suitable for food and cover. The grass cover on the unit provides protection for newborn pronghorn fawns.

If this unit is used for homesite development, the main limitations are the hazard of flooding and shrink-swell potential. Dikes and channels that have outlets for floodwater can be used to protect buildings and onsite sewage disposal systems from flooding. Roads and streets should be located above the expected flood level. If buildings are constructed on the soil in this unit, properly designing foundations and footings and diverting runoff away from buildings help to prevent structural damage because of shrinking and swelling.

If the soil in this unit is used for septic tank absorption fields, the main limitations are the hazard of flooding and very slow permeability. Use of sandy backfill for the trench and long absorption lines helps to compensate for the very slow permeability.

This map unit is in capability subclass VIIs.

27—Palma sandy loam, 0 to 5 percent slopes. This deep, well drained soil is on fan terraces. It formed in wind-worked alluvium derived from mixed sources. Elevation is 5,000 to 6,000 feet. The average annual precipitation is 12 to 14 inches, the average annual air temperature is 52 to 54 degrees F, and the average frost-free period is 140 to 175 days.

Typically, the surface layer is brown sandy loam 6 inches thick. The subsoil is yellowish red sandy loam about 32 inches thick. The substratum to a depth of 60 inches or more is yellowish red sandy loam.

Included in this unit are small areas of gently sloping Clovis, Keeseha, and Poley soils on the tops of fan terraces, Mespun soils in hummocky areas, and Rune soils on alluvial fans. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

Permeability of this Palma soil is moderately rapid. Available water capacity is medium. Water supplying capacity is 12 to 14 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high.

This unit is used as rangeland and for wildlife habitat. It can be used for irrigated crops if water is made available.

The potential plant community on this unit is mainly Indian ricegrass, blue grama, galleta, and needleandthread. If the range is poorly managed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community.

Livestock grazing should also be managed to protect the unit from excessive erosion. Good accessibility, a large variety of palatable plants, and availability of water encourage a constant grazing pressure. Proper grazing use, range seeding, and a planned system of grazing are needed to maintain or improve the production of forage. Seeding suitable plants helps to control blowing and drifting of sand. This unit responds more readily to proper management than do most of the other units in the survey area.

The unit is poorly suited to livestock watering ponds and other water impoundments because of the seepage potential. The included Rune soils are suited to this use.

Elk and deer use this unit as winter range. The grass cover on the unit provides protection for newborn pronghorn fawns. Burrowing animals prefer this unit to most of the other units in the survey area.

This unit is well suited to homesite development. It has few limitations. The soil in this unit is susceptible to settling if structures are built on it. Settlement can be minimized by compacting the soil.

This map unit is in capability subclass VIe.

28—Pastura gravelly loam, 0 to 8 percent slopes. This very shallow and shallow, well drained soil is on fan terraces. It formed in alluvium and colluvium derived dominantly from limestone, sandstone, and pyroclastics. Elevation is 5,000 to 5,500 feet. The average annual precipitation is 12 to 14 inches, the average annual air temperature is 50 to 54 degrees F, and the average frost-free period is 130 to 170 days.

Typically, the surface layer is brown gravelly loam 2 inches thick. The subsurface layer is brown loam 4 inches thick. The subsoil is very pale brown gravelly loam 5 inches thick. A lime-cemented hardpan is at a depth of 11 inches. Depth to the hardpan ranges from 6 to 20 inches. In some areas the surface layer is loam.

Included in this unit are small areas of Pastura soils on slightly steeper side slopes, Poley gravelly loam on foot slopes, and Lynx and Rune soils on alluvial fans and flood plains. Included areas make up about 10 percent of the total acreage. The percentage varies from one area to another.

Permeability of this Pastura soil is moderate. Available water capacity is very low. Water supplying capacity is 12 to 14 inches. Effective rooting depth is 6 to 20 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is slight.

This unit is used as rangeland and for wildlife habitat.

The potential plant community on this unit is mainly sideoats grama, black grama, blue grama, and needleandthread. The production of forage is limited by very shallow and shallow depth to the hardpan and very low available water capacity. If the range is poorly managed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community.

Suitable range management practices are fencing, implementing planned grazing systems, and developing water for livestock. Where a seed source is lacking in mismanaged areas or where competition from undesirable shrubby plants exists, desirable plants are slow to recover on this unit.

This unit is poorly suited to livestock watering ponds and other water impoundments because of the depth to the hardpan. The included Lynx and Rune soils are suited to this use.

If this unit is used for homesite development, the main limitation is the depth to the cemented pan. Excavation for buildings and roads is limited by the very shallow and shallow depth to the pan. Because removal of the pan to an adequate depth could be costly, consider the use of construction methods that do not require excavation.

The use of the soil in this unit for septic tank absorption fields is limited by the depth to the cemented pan. Consider the use of holding tanks or evaporative beds.

This map unit is in capability subclass VIs.

29—Paymaster-Lynx association, gently sloping. This map unit is on long, narrow stream terraces and low alluvial fans. Slope is 0 to 8 percent. Elevation is 5,400 to 6,400 feet. The average annual precipitation is 12 to 16 inches, the average annual air temperature is 50 to 54 degrees F, and the average frost-free period is 130 to 170 days.

This unit is 50 percent Paymaster sandy loam and 40 percent Lynx loam.

Included in this unit are small areas of Boysag, Poley, Tusayan, and Winona soils on side slopes adjacent to drainageways and Rune soils on alluvial fans. Included areas make up about 10 percent of the total acreage. The percentage varies from one area to another.

The Paymaster soil is deep and well drained. It formed in alluvium derived from mixed sources. Typically, the surface layer is brown sandy loam 6 inches thick. The subsurface layer is brown loam 24 inches thick. The upper 12 inches of the underlying material is yellowish brown loam. The lower part to a depth of 60 inches or more is yellowish brown gravelly sandy loam.

Permeability of the Paymaster soil is moderate. Available water capacity is high. Water supplying capacity is 11 to 14 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high. This soil is subject to rare, brief periods of flooding in winter and spring.

The Lynx soil is deep and well drained. It formed in alluvium derived from mixed sources. Typically, the surface layer is brown loam 2 inches thick. The subsurface layer is brown clay loam 34 inches thick. The underlying material to a depth of 60 inches or more is reddish brown clay loam.

Permeability of the Lynx soil is moderately slow. Available water capacity is high. Water supplying capacity is 11 to 14 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is moderate. The hazard of soil blowing is slight. This soil is subject to brief periods of flooding in winter and spring.

This unit is used as rangeland and for wildlife habitat. It can be used for irrigated crops if water is made available.

The potential plant community on this unit is mainly western wheatgrass, vine-mesquite, blue grama, and

fourwing saltbush. If the range is poorly managed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. If the plant cover is disturbed, protection from flooding is needed to control gullying, streambank cutting, and sheet erosion.

Proper grazing use, range seeding, and a planned system of grazing are needed to maintain or improve the production of forage. Livestock prefer this unit to most others in the survey area because of accessibility and the availability of water. This results in overgrazing and subsequent deterioration of the vegetation.

The unit is poorly suited to livestock watering ponds and other water impoundments because of the seepage potential in the Paymaster soil and the slope of the Lynx soil. The included Rune soils are suited to this use.

Use of this unit by wildlife is restricted mainly to the drainageways, which provide diverse vegetation suitable for food and cover. The quality and quantity of browse on this unit encourage the concentration of big game animals. Big game animals and livestock compete for food and cover in winter. Elk and deer use this unit as winter range. The grass cover on the unit provides protection for newborn pronghorn fawns. Burrowing animals use this unit more than most of the other units in the survey area.

If the Paymaster soil is used for homesite development, the main limitation is the hazard of flooding. Dikes and channels that have outlets for floodwater can be used to protect buildings and onsite sewage disposal systems from flooding. The soil is susceptible to settling if structures are built on it. Settlement can be minimized by compacting the soil.

If the Lynx soil is used for homesite development, the main limitations are shrink-swell potential and the hazard of flooding. The effects of shrinking and swelling can be minimized by using proper engineering designs and by backfilling with material that has low shrink-swell potential. Dikes and channels that have outlets for floodwater can be used to protect buildings and onsite sewage disposal systems from flooding.

If the soils in this unit are used for septic tank absorption fields, the main limitations are the moderately slow permeability of the Lynx soil and the hazard of flooding. The limitation of moderately slow permeability can be overcome by increasing the size of the absorption field.

This map unit is in capability subclass VIc.

30—Poley sandy loam, 0 to 5 percent slopes. This deep, well drained soil is on fan terraces. It formed in alluvium derived dominantly from limestone, sandstone, shale, and quartzite. Elevation is 5,200 to 5,600 feet. The average annual precipitation is 12 to 14 inches, the average annual air temperature is 50 to 54 degrees F, and the average frost-free period is 130 to 170 days.

Typically, the surface layer is light brown sandy loam 4 inches thick. The upper 6 inches of the subsoil is reddish brown clay loam. The lower 12 inches is yellowish red clay. The upper 18 inches of the substratum is pink gravelly loam. The lower part to a depth of 60 inches or more is yellowish red very gravelly sandy loam.

Included in this unit are small areas of Poley gravelly sandy loam, Poley gravelly loam, and Keeseha gravelly sandy loam on the tops of fan terraces, Clovis soils and Palma sandy loam on side slopes, and Lynx and Rune soils on alluvial fans. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

Permeability of this Poley soil is slow to a depth of 22 inches and moderate below this depth. Available water capacity is high. Water supplying capacity is 11 to 13 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high.

This unit is used as rangeland and for wildlife habitat. It can be used for irrigated crops if water is made available.

The potential plant community on this unit is mainly blue grama, black grama, needleandthread, and Indian ricegrass. If the range is poorly managed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Livestock grazing should also be managed to protect the unit from excessive erosion.

This unit is suitable for year-round grazing, and it generally provides moderately high yields of forage. Proper grazing use, range seeding, and a planned system of grazing are needed to maintain or improve the production of forage. The unit responds more readily to proper management than do most of the other units in the survey area.

This unit is poorly suited to livestock watering ponds and other water impoundments because of the seepage potential. The included Rune soil is suited to this use.

Elk and deer use this unit as winter range. The grass cover on the unit provides protection for newborn pronghorn fawns. Burrowing animals use this unit more than most of the other units in the survey area.

This unit is well suited to homesite development.

The use of this unit for septic tank absorption fields is limited by slow permeability. Absorption lines should be placed below the slowly permeable layer. Increasing the size of the absorption area also helps to compensate for the slow permeability.

This map unit is in capability subclass VIe.

31—Poley gravelly loam, 0 to 8 percent slopes. This deep, well drained soil is on fan terraces. It formed in alluvium derived dominantly from sandstone, limestone, shale, and quartzite. Elevation is 5,200 to 6,200 feet. The average annual precipitation is 12 to 14

inches, the average annual air temperature is 50 to 54 degrees F, and the average frost-free period is 130 to 170 days.

Typically, the surface layer is light brown gravelly loam 4 inches thick. The upper 6 inches of the subsoil is reddish brown clay loam. The lower 12 inches is yellowish red clay. The upper 18 inches of the substratum is pink gravelly loam. The lower part to a depth of 60 inches or more is yellowish red very gravelly sandy loam.

Included in this unit are small areas of Lynx loam and Paymaster and Rune soils on recent alluvial fans, Clovis soils and Keeseha gravelly sandy loam on fan terraces, and Tusayan and Winona gravelly loams on ridges. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

Permeability of this Poley soil is slow to a depth of 22 inches and moderate below this depth. Available water capacity is high. Water supplying capacity is 12 to 14 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is moderate. The hazard of soil blowing is slight.

This unit is used as rangeland and for wildlife habitat. It can be used for irrigated crops if water is made available.

The potential plant community on this unit is mainly black grama, blue grama, galleta, and Indian ricegrass. If the range is poorly managed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Suitable range management practices are fencing, implementing planned grazing systems, and developing water for livestock.

The unit is poorly suited to livestock watering ponds and other water impoundments because of the seepage potential and slope. The included Rune soil is suited to this use.

Elk and deer use this unit as winter range. The grass cover on the unit provides protection for newborn pronghorn fawns. Burrowing animals use this unit more than most of the other units in the survey area.

This unit is well suited to homesite development.

The use of the soil in this unit for septic tank absorption fields is limited by slow permeability. Absorption lines should be placed below the slowly permeable layer. Increasing the size of the absorption area also helps to compensate for the slow permeability.

This map unit is in capability subclass VIs.

32—Poley-Lynx association, gently sloping. This map unit is on fan terraces and alluvial fans. Slope is 0 to 8 percent. Elevation is 5,200 to 6,100 feet. The average annual precipitation is 12 to 14 inches, the average annual air temperature is 50 to 54 degrees F, and the average frost-free period is 130 to 170 days.

This unit is 60 percent Poley gravelly loam and 30 percent Lynx loam. The Poley soil is gently sloping to sloping and is on fan terraces. The Lynx soil is nearly level and is on alluvial fans.

Included in this unit are small areas of Paymaster and Rune soils on flood plains and fan terraces. Also included are small areas of Clovis soils and Tusayan gravelly loam on fan terraces and plateaus. Included areas make up about 10 percent of the total acreage. The percentage varies from one area to another.

The Poley soil is deep and well drained. It formed in mixed alluvium derived dominantly from sandstone and limestone. Typically, the surface layer is light brown gravelly loam 4 inches thick. The upper 6 inches of the subsoil is reddish brown clay loam. The lower 16 inches is yellowish red clay. The upper 18 inches of the substratum is pink gravelly loam. The lower part to a depth of 60 inches or more is yellowish red very gravelly sandy loam.

Permeability of the Poley soil is slow. Available water capacity is high. Water supplying capacity is 12 to 14 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is moderate. The hazard of soil blowing is slight.

The Lynx soil is deep and well drained. It formed in mixed alluvium derived dominantly from sandstone, limestone, and basalt. Typically, the surface layer is brown loam 2 inches thick. The subsurface layer is brown clay loam 34 inches thick. The underlying material to a depth of 60 inches or more is light brown clay loam.

Permeability of the Lynx soil is moderately slow. Available water capacity is high. Water supplying capacity is 11 to 13 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is moderate. The hazard of soil blowing is slight. This soil is subject to rare, brief periods of flooding in winter and spring.

This unit is used as rangeland and for wildlife habitat. It can be used for irrigated crops if water is made available.

The potential plant community on the Poley soil is mainly black grama, blue grama, galleta, and Indian ricegrass. If the range is poorly managed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community.

Good accessibility, a large variety of palatable plants, and availability of water encourage a constant grazing pressure. This soil is suitable for year-round grazing, and it generally provides moderately high yields of forage.

The potential plant community on the Lynx soil is mainly western wheatgrass, blue grama, vine-mesquite, and fourwing saltbush. If the plant cover is disturbed, protection from flooding is needed to control gullying, streambank cutting, and sheet erosion.

Good accessibility, a large variety of palatable plants, and availability of water encourage a constant grazing

pressure. This soil is suitable for year-round grazing, and it generally provides high yields of forage. Proper grazing use, range seeding, and a planned system of grazing are needed to maintain or improve the production of forage.

The Poley soil is poorly suited to livestock watering ponds and other water impoundments because of the seepage potential and slope. The Lynx soil and the included Rune soil are suited to this use.

Elk and deer use this unit as winter range. The grass cover on the unit provides protection for newborn pronghorn fawns. Burrowing animals use this unit more than most of the other units in the survey area.

The Poley soil is well suited to homesite development.

The use of this soil for septic tank absorption fields is limited by slow permeability. Absorption lines should be placed below the slowly permeable layer. Increasing the size of the absorption area helps to compensate for the slow permeability.

If the Lynx soil is used for homesite development, the main limitations are the hazard of flooding and moderate shrink-swell potential. If buildings are constructed on this soil, properly designing foundations and footings and diverting runoff away from buildings help to prevent structural damage because of shrinking and swelling. Dikes and channels that have outlets for floodwater can be used to protect buildings and onsite sewage disposal systems from flooding.

If this soil is used for septic tank absorption fields, the main limitations are the hazard of flooding and moderately slow permeability. The limitation of moderately slow permeability can be overcome by increasing the size of the absorption field.

This map unit is in capability subclass VIs.

33—Poley-Tusayan association, gently sloping. This map unit is on fan terraces and plateaus. Slope is 0 to 8 percent. Elevation is 5,500 to 6,800 feet. The average annual precipitation is 12 to 14 inches, the average annual air temperature is 50 to 54 degrees F, and the average frost-free period is 130 to 170 days.

This unit is 60 percent Poley gravelly loam and 30 percent Tusayan gravelly loam.

Included in this unit are small areas of Paymaster soils and Lynx loam on alluvial fans and flood plains, Winona soils on ridges, and Rune silty clay loam on alluvial fans. Included areas make up about 10 percent of the total acreage. The percentage varies from one area to another.

The Poley soil is deep and well drained. It formed in mixed alluvium derived dominantly from sandstone, limestone, shale, and quartzite. Typically, the surface layer is brown gravelly loam 4 inches thick. The subsurface layer is reddish brown clay loam 6 inches thick. The subsoil is yellowish red clay 12 inches thick. The upper 18 inches of the substratum is pink gravelly loam. The lower part to a depth of 60 inches or more is yellowish red very gravelly sandy loam.

Permeability of the Poley soil is slow to a depth of 22 inches and moderate below this depth. Available water capacity is high. Water supplying capacity is 12 to 14 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is moderate. The hazard of soil blowing is slight.

The Tusayan soil is moderately deep and well drained. It formed in alluvial and eolian deposits derived dominantly from limestone and calcareous sandstone. Typically, the surface layer is brown gravelly loam 3 inches thick. The subsurface layer is brown gravelly loam about 7 inches thick. The upper 6 inches of the subsoil is light brownish gray gravelly loam. The lower 11 inches is brown extremely gravelly loam. The substratum is light brown very gravelly loam about 2 inches thick. Calcareous sandstone is at a depth of 29 inches. Depth to sandstone ranges from 20 to 40 inches.

Permeability of the Tusayan soil is moderate. Available water capacity is very low. Water supplying capacity is 12 to 14 inches. Effective rooting depth is 20 to 40 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is slight.

This unit is used as rangeland and for wildlife habitat.

The potential plant community on this unit is mainly black grama, blue grama, galleta, sideoats grama, and Indian ricegrass. The production of forage on the Tusayan soil is limited by the high content of lime and depth to bedrock. Good accessibility, a large variety of palatable plants, and availability of water encourage a constant grazing pressure. Suitable range management practices are fencing, implementing planned grazing systems, and developing water for livestock.

The Poley soil is poorly suited to livestock watering ponds and other water impoundments because of the seepage potential and slope. The Tusayan soil is poorly suited because of depth to rock and slope. The included Rune soils are suited to this use.

Elk and deer use this unit as winter range. The grass cover on the unit provides protection for newborn pronghorn fawns. Burrowing animals use this unit more than most of the other units in the survey area.

The Poley soil is well suited to homesite development.

The use of this soil for septic tank absorption fields is limited by slow permeability. Absorption lines should be placed below the slowly permeable layer. Increasing the size of the absorption area helps to compensate for the slow permeability.

If the Tusayan soil is used for homesite development, the main limitation is depth to rock. Cuts needed to provide essentially level building sites can expose bedrock.

The use of this soil for septic tank absorption fields is limited by depth to rock. Increasing the size of the absorption field helps to compensate for this limitation.

This map unit is in capability subclass VIs.

34—Purgatory gravelly fine sandy loam, 0 to 8 percent slopes. This moderately deep, well drained soil is on plateaus and mesas. It formed in alluvial and eolian deposits derived dominantly from gypsiferous, sandy

shale. Elevation is 4,900 to 5,300 feet. The average annual precipitation is 6 to 8 inches, the average annual air temperature is 52 to 55 degrees F, and the average frost-free period is 150 to 175 days.

Included in this unit are small areas of Ives, Navajo, and Tours soils on alluvial fans and flood plains; nearly level Epikom soils on plateaus; and outcroppings of gypsum and shale on side slopes. Included areas make up about 15 percent of the total acreage. The percentage varies from one area to another.

Typically, the surface layer is yellowish red gravelly fine sandy loam 2 inches thick. The upper 12 inches of the underlying material is variegated pink and yellowish red sandy loam. The lower part, to a depth of 34 inches, is light gray clay loam that is high in content of gypsum. Weathered, thin-bedded shale is at a depth of 34 inches. Depth to shale ranges from 20 to 40 inches. In some areas the surface layer is fine sandy loam or very gravelly fine sandy loam.

Permeability of the Purgatory soil is moderate. Available water capacity is medium. Water supplying capacity is 6 to 8 inches. Effective rooting depth is 20 to 40 inches. Runoff is slow, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

This unit is used as rangeland and for wildlife habitat.

The potential plant community on this unit is mainly galleta, gyp dropseed, alkali sacaton, and fourwing saltbush. The production of forage is limited by the high content of gypsum in the soil. If the range is poorly managed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community.

Livestock grazing should also be managed to protect the unit from excessive soil blowing. Suitable range management practices are fencing, implementing planned grazing systems, and developing water for livestock. Where a seed source is lacking in mismanaged areas or where competition from undesirable shrubby plants exists, desirable plants are slow to recover on this unit.

The unit is limited for livestock watering ponds and other water impoundments because of seepage potential, depth to rock, slope, and the possibility of solution cavities forming.

Use of this unit by wildlife is restricted mainly to the drainageways, which provide diverse vegetation suitable for food and cover.

If this unit is used for homesite development, the main limitations are depth to bedrock and shrink-swell potential. Cuts needed to provide essentially level building sites can expose bedrock. If buildings are constructed on the soil in this unit, properly designing foundations and footings and diverting runoff away from buildings help to prevent structural damage because of shrinking and swelling.

The use of this unit for septic tank absorption fields is limited by depth to bedrock and the possibility of solution cavities forming. Use of long absorption lines and sandy backfill for the trench helps to compensate for these limitations.

This map unit is in capability subclass VIIs.

35—Quivera very gravelly loam, 0 to 8 percent slopes. This deep, well drained soil is on fan terraces. It formed in alluvium derived dominantly from pyroclastics. Elevation is 5,700 to 6,800 feet. The average annual precipitation is 12 to 14 inches, the average annual air temperature is 49 to 54 degrees F, and the average frost-free period is 130 to 170 days.

Typically, the surface layer is brown very gravelly loam 3 inches thick. The subsoil is brown gravelly clay 25 inches thick. The substratum to a depth of 60 inches or more is strongly calcareous, light brown very gravelly loam.

Included in this unit are small areas of gently sloping Ashfork, Aut, and Winona soils on plateaus, moderately sloping Ziegler soils on fan terraces, and Rune soils on alluvial fans. Included areas make up about 15 percent of the total acreage. The percentage varies from one area to another.

Permeability of this Quivera soil is slow to a depth of 18 inches and moderate below this depth. Available water capacity is medium. Water supplying capacity is 11 to 15 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is slight.

This unit is used as rangeland and for wildlife habitat.

The potential plant community on this unit is mainly blue grama, black grama, hairy grama, and galleta. If the range is poorly managed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community.

This unit is suitable for year-round grazing, and it generally provides moderately high yields of forage. Suitable range management practices are fencing, implementing planned grazing systems, and developing water for livestock.

This unit is poorly suited to livestock watering ponds and other water impoundments because of the seepage potential and slope. The included Rune soils are suited to this use.

Elk and deer use this unit as winter range. Big game animals and livestock compete for the diverse vegetation and water available on the unit. The grass cover on the unit provides protection for newborn pronghorn fawns. Burrowing animals use this unit more than most of the other units in the survey area.

If this unit is used for homesite development, the main limitation is shrink-swell potential. The effects of shrinking and swelling can be minimized by using proper engineering designs and by backfilling with material that has low shrink-swell potential.

The use of the soil in this unit for septic tank absorption fields is limited by slow permeability.

Absorption lines should be placed below the slowly permeable layer.

This map unit is in capability subclass VIs.

36—Riverwash. Riverwash consists of deep, highly stratified soil material that is subject to frequent overflow. It is on the flood plains of the Little Colorado River. New material is deposited and old material shifted each time the river overflows. Some reworking by wind has deposited temporary dunes. Slope is 0 to 3 percent. Elevation is 4,200 to 4,500 feet. The average annual precipitation is 4 to 6 inches, the average annual air temperature is 53 to 57 degrees F, and the average frost-free period is 150 to 200 days.

Included in this unit are small areas of Ives sandy loam, Navajo clay, and Tours fine sandy loam.

This unit is used for wildlife habitat.

This unit is poorly suited to all engineering uses because of frequent periods of flooding.

This map unit is in capability subclass VIIIw.

37—Rune silty clay loam, 0 to 8 percent slopes. This deep, well drained soil is on stream terraces and alluvial fans. It formed in alluvium derived dominantly from sandstone, limestone, shale, and basalt. Elevation is 5,000 to 5,900 feet. The average annual precipitation is 12 to 16 inches, the average annual air temperature is 50 to 54 degrees F, and the average frost-free period is 130 to 170 days.

Typically, the surface layer is reddish brown silty clay loam 3 inches thick. Below this to a depth of 60 inches or more is reddish brown silty clay.

Included in this unit are small areas of Servilleta, Disterheff, Paymaster, and Lynx soils. Included areas make up about 15 percent of the total acreage. The percentage varies from one area to another.

Permeability of this Rune soil is slow. Available water capacity is high. Water supplying capacity is 11 to 14 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is moderate. The hazard of soil blowing is moderate. This soil is subject to rare, brief periods of flooding in winter and spring.

This unit is used as rangeland and for wildlife habitat. It can be used for irrigated crops if water is made available.

The potential plant community on this unit is mainly blue grama, western wheatgrass, alkali sacaton, and fourwing saltbush. If the range is poorly managed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. If the plant cover is disturbed, protection from flooding is needed to control gullying, streambank cutting, and sheet erosion.

Good accessibility, a large variety of palatable plants, and availability of water on this unit encourage a constant grazing pressure. The unit is suitable for year-round grazing, and it generally provides high yields of forage. Suitable range management practices are fencing, implementing planned grazing systems, and developing water for livestock.

This unit generally is suited to livestock watering ponds and other water impoundments, but moderately sloping areas are poorly suited to this use.

Use of this unit by wildlife is restricted mainly to the drainageways, which provide diverse vegetation suitable for food and cover. The grass cover on the unit provides protection for newborn pronghorn fawns, and the riparian vegetation provides food, cover, and nesting areas for wildlife.

If this unit is used for homesite development, the main limitations are the hazard of flooding and shrink-swell potential. Dikes and channels that have outlets for floodwater can be used to protect buildings and onsite sewage disposal systems from flooding. Roads and streets should be located above the expected flood level. If buildings are constructed on this unit, properly designing foundations and footings and diverting runoff away from buildings help to prevent structural damage because of shrinking and swelling.

The use of the soil in this unit for septic tank absorption fields is limited by the hazard of flooding and slow permeability. Use of sandy backfill for the trench and long absorption lines helps to compensate for the slow permeability.

This map unit is in capability subclass VIs.

38—Rune-Disterheff association, gently sloping. This map unit is on stream terraces, alluvial fans, and fan terraces. Slope is 0 to 8 percent. Elevation is 5,000 to 6,000 feet. The average annual precipitation is 12 to 16 inches, the average annual air temperature is 50 to 54 degrees F, and the average frost-free period is 130 to 170 days.

This unit is 50 percent Rune silty clay loam and 40 percent Disterheff cobbly sandy clay loam. The Rune soil is on stream terraces and alluvial fans; slope is mainly 0 to 3 percent. The Disterheff soil is on fan terraces; slope is 2 to 8 percent.

Included in this unit are small areas of other Disterheff soils on side slopes and Paymaster and Lynx soils on alluvial fans. Included areas make up about 10 percent of the total acreage. The percentage varies from one area to another.

The Rune soil is deep and well drained. It formed in alluvium derived dominantly from shale, sandstone, limestone, and basalt. Typically, the surface layer is reddish brown silty clay loam 3 inches thick. Below this to a depth of 60 inches or more is reddish brown silty clay.

Permeability of the Rune soil is slow. Available water capacity is high. Water supplying capacity is 12 to 16 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is

moderate. The hazard of soil blowing is moderate. This soil is subject to rare, brief periods of flooding in winter and spring.

The Disterheff soil is deep and well drained. It formed in alluvium and colluvium derived dominantly from pyroclastics, quartzite, and basalt. Typically, the surface layer is light brown cobbly sandy clay loam 3 inches thick. The subsurface layer is brown gravelly clay loam about 4 inches thick. The upper 18 inches of the subsoil is dark red gravelly clay and clay. The lower 6 inches is red very gravelly clay loam. The substratum to a depth of 60 inches or more is strongly calcareous, white very cobbly clay loam.

Permeability of the Disterheff soil is slow. Available water capacity is high. Water supplying capacity is 12 to 16 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is slight.

This unit is used as rangeland and for wildlife habitat. The Rune soil can be used for irrigated crops if water is made available.

The potential plant community on the Rune soil is mainly blue grama, western wheatgrass, alkali sacaton, and fourwing saltbush. If the plant cover is disturbed, protection from flooding is needed to control gullying, streambank cutting, and sheet erosion. Good accessibility, a large variety of palatable plants, and availability of water encourage a constant grazing pressure. Suitable range management practices are fencing, implementing planned grazing systems, and developing water for livestock. This soil is suited to the construction of livestock water impoundments.

The potential plant community on the Disterheff soil is mainly galleta, western wheatgrass, black grama, blue grama, and sideoats grama. If the range is poorly managed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Suitable range management practices are fencing, implementing planned grazing systems, and developing water for livestock. The Disterheff soil is limited for livestock watering ponds and other water impoundments because of slope.

Elk and deer use this unit as winter range. Grass cover on the unit provides protection for newborn pronghorn fawns.

If the Rune soil is used for homesite development, the main limitations are the hazard of flooding and shrink-swell potential. Dikes and channels that have outlets for floodwater can be used to protect buildings and onsite sewage disposal systems from flooding. Roads and streets should be located above the expected flood level. The effects of shrinking and swelling can be minimized by using proper engineering designs and by backfilling with material that has low shrink-swell potential.

The use of the Rune soil for septic tank absorption fields is limited by the hazard of flooding and slow permeability. The limitation of slow permeability can be overcome by increasing the size of the absorption field.

If the Disterheff soil is used for homesite development, the main limitation is shrink-swell potential. If buildings are constructed on this soil, properly designing foundations and footings and diverting runoff away from buildings help to prevent structural damage because of shrinking and swelling.

The use of the Disterheff soil for septic tank absorption fields is limited by slow permeability. This limitation can be overcome by increasing the size of the absorption field.

This map unit is in capability subclass VIs.

39—Servilleta fine sandy loam, 1 to 8 percent slopes. This moderately deep, well drained soil is in slightly concave areas on plateaus. It formed in alluvium derived dominantly from shale, sandstone, and quartzite. Elevation is 5,500 to 6,000 feet. The average annual precipitation is 12 to 14 inches, the average annual air temperature is 49 to 54 degrees F, and the average frost-free period is 130 to 160 days.

Typically, the surface layer is light reddish brown fine sandy loam 2 inches thick. The upper 4 inches of the subsoil is reddish brown clay loam. The lower 11 inches is reddish brown clay. The substratum is pink clay loam and gravelly clay loam 18 inches thick over fractured sandy shale. Depth to shale ranges from 20 to 40 inches.

Included in this unit are small areas of Kopie gravelly fine sandy loam and Tusayan gravelly loam in convex areas, Poley gravelly loam on fan terraces, and Lynx loam and Rune silty clay loam in drainageways. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

Permeability of this Servilleta soil is slow. Available water capacity is high. Water supplying capacity is 11 to 13 inches. Effective rooting depth is 20 to 40 inches. Runoff is slow, and the hazard of water erosion is high. The hazard of soil blowing is high.

This unit is used as rangeland and for wildlife habitat.

The potential plant community on this unit is mainly blue grama, galleta, western wheatgrass, and fourwing saltbush. If the range is poorly managed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community.

This unit is suitable for year-round grazing, and it generally provides high yields of forage. Proper grazing use, range seeding, and a planned system of grazing are needed to maintain or improve the production of forage.

This unit is poorly suited to livestock watering ponds and other water impoundments because of depth to rock and slope. The included Poley, Lynx, and Rune soils are suited to this use.

Elk and deer use this unit as winter range. The grass cover on the unit provides protection for newborn pronghorn fawns.

If this unit is used for homesite development, the main limitations are shrink-swell potential and depth to bedrock. The effects of shrinking and swelling can be minimized by using proper engineering designs and by backfilling with material that has low shrink-swell potential. Cuts needed to provide essentially level building sites can expose bedrock.

If the unit is used for septic tank absorption fields, the main limitations are slow permeability and depth to bedrock. Use of long absorption lines and sandy backfill for the trench helps to compensate for these limitations.

This map unit is in capability subclass VIs.

40—Servilleta-Tusayan complex, 1 to 8 percent slopes. This map unit is on plateaus and mesas. Elevation is 5,500 to 6,000 feet. The average annual precipitation is 12 to 14 inches, the average annual air temperature is 49 to 54 degrees F, and the average frost-free period is 130 to 160 days.

This unit is 50 percent Servilleta fine sandy loam and 40 percent Tusayan gravelly sandy loam. The Servilleta soil is in concave areas, and the Tusayan soil is in convex areas. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Lynx loam and Rune silty clay loam on alluvial fans and in drainageways and Winona gravelly loam on plateaus and broad ridges. Included areas make up about 10 percent of the total acreage. The percentage varies from one area to another.

The Servilleta soil is moderately deep and well drained. It formed in alluvium derived dominantly from shale, sandstone, and quartzite. Typically, the surface layer is light reddish brown fine sandy loam 2 inches thick. The upper 4 inches of the subsoil is reddish brown clay loam. The next 11 inches is reddish brown clay. The substratum is pink gravelly clay loam 18 inches thick over fractured shale. Depth to bedrock ranges from 20 to 40 inches.

Permeability of the Servilleta soil is slow. Available water capacity is high. Water supplying capacity is 11 to 13 inches. Effective rooting depth is 20 to 40 inches. Runoff is slow, and the hazard of water erosion is high. The hazard of soil blowing is high.

The Tusayan soil is moderately deep and well drained. It formed in alluvial and eolian deposits derived dominantly from limestone and calcareous sandstone. Typically, the surface layer is brown gravelly sandy loam 3 inches thick. The subsurface layer is brown gravelly loam about 7 inches thick. The upper 6 inches of the subsoil is light brownish gray gravelly loam. The lower 11 inches is brown extremely gravelly loam. The substratum is light brown very gravelly loam about 2 inches thick. Calcareous sandstone is at a depth of 29 inches. Depth to sandstone ranges from 20 to 40 inches.

Permeability of the Tusayan soil is moderate. Available water capacity is very low. Water supplying capacity is 12 to 14 inches. Effective rooting depth is 20 to 40 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is slight.

This unit is used as rangeland and for wildlife habitat.

The potential plant community on the Servilleta soil is mainly blue grama, galleta, western wheatgrass, and fourwing saltbush. The potential plant community on the Tusayan soil is mainly black grama, blue grama, sideoats grama, needleandthread, and New Mexico feathergrass. If the range is poorly managed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community.

This unit is suitable for year-round grazing, and it generally provides high yields of forage. Proper grazing use, range seeding, and a planned system of grazing are needed to maintain or improve the production of forage.

The unit is poorly suited to livestock watering ponds and other water impoundments because of depth to rock and slope. The included Lynx and Rune soils are well suited to this use.

Elk and deer use this unit as winter range. The grass cover on the unit provides protection for newborn pronghorn fawns.

If the Servilleta soil is used for homesite development, the main limitations are shrink-swell potential and depth to bedrock. The effects of shrinking and swelling can be minimized by using proper engineering designs and by backfilling with material that has low shrink-swell potential. Cuts needed to provide essentially level building sites can expose bedrock.

If the Servilleta soil is used for septic tank absorption fields, the main limitations are slow permeability and depth to bedrock. Use of long absorption lines and sandy backfill for the trench helps to compensate for these limitations.

If the Tusayan soil is used for homesite development, the main limitation is depth to bedrock. Cuts needed to provide essentially level building sites can expose bedrock.

If the Tusayan soil is used for septic tank absorption fields, the main limitation is depth to bedrock. Increasing the size of the absorption field helps to compensate for this limitation.

This map unit is in capability subclass VIs.

41—Showlow gravelly fine sandy loam, 0 to 8 percent slopes. This deep, well drained soil is on fan terraces. It formed in alluvium derived dominantly from sandstone, shale, quartzite, and limestone. Elevation is 5,600 to 6,600 feet. The average annual precipitation is 12 to 16 inches, the average annual air temperature is 50 to 54 degrees F, and the average frost-free period is 130 to 170 days.

Typically, the surface layer is dark brown gravelly fine sandy loam 2 inches thick. The upper 8 inches of the

subsoil is reddish brown gravelly clay loam. The lower 17 inches is reddish brown and red gravelly clay. The substratum to a depth of 60 inches or more is reddish yellow gravelly sandy clay loam and very gravelly clay loam.

Included in this unit are small areas of Deama gravelly loam on mesas; Disterheff soils on some south-facing side slopes of fan terraces; and Paymaster, Lynx, and Rune soils on alluvial fans and stream terraces. Included areas make up about 15 percent of the total acreage. The percentage varies from one area to another.

Permeability of this Showlow soil is slow. Available water capacity is high. Water supplying capacity is 12 to 16 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is moderate. The hazard of soil blowing is slight.

This unit is used as grazable woodland and for firewood harvesting and wildlife habitat.

This unit is well suited to the production of Utah juniper, oneseed juniper, and pinyon. The average site index is 60. The unit can produce 7.5 cords per acre in a stand of trees that average 5 inches in diameter at a height of 1 foot.

Management that minimizes the hazard of erosion is essential in harvesting firewood. Disturbed areas can be protected from erosion by seeding adapted plants. Plant competition delays natural regeneration but generally does not prevent the eventual development of a fully stocked, normal stand of trees. Brushy plants such as turbinella oak limit natural regeneration of Utah juniper. To maintain production of wood crops and forage, therefore, management may be needed to control turbinella oak.

This unit has moderate potential for production of understory forage. The preferred forage plants are blue grama, sideoats grama, bottlebrush squirreltail, and pinyon ricegrass. Thinning of dense stands of trees may be desirable where livestock grazing is the main use.

If the understory vegetation is poorly managed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Planned grazing systems are essential to maintain plant vigor and forage production. Where a seed source is lacking in mismanaged areas or where competition from undesirable shrubby plants exists, desirable plants are slow to recover on this unit.

This unit is poorly suited to livestock watering ponds and other water impoundments because of slope. The included Rune soils are suited to this use.

Maintenance of snags with more than 40 percent bark is essential for birds that nest in cavities. Pinyon nut production is important for wildlife.

If this unit is used for homesite development, the main limitation is shrink-swell potential. The effects of shrinking and swelling can be minimized by using proper engineering designs and by backfilling with material that has low shrink-swell potential.

The use of the unit for septic tank absorption fields is limited by slow permeability. Use of sandy backfill for the trench and long absorption lines helps to compensate for this limitation.

This map unit is in capability subclass VIs.

42—Showlow gravelly fine sandy loam, 8 to 30 percent slopes. This deep, well drained soil is on hillsides. It formed in mixed alluvium. Elevation is 5,800 to 6,000 feet. The average annual precipitation is 12 to 16 inches, the average annual air temperature is 50 to 54 degrees F, and the average frost-free period is 130 to 170 days.

Typically, the surface layer is dark brown gravelly fine sandy loam 2 inches thick. The upper 8 inches of the subsoil is reddish brown gravelly clay loam. The lower 17 inches is red and reddish brown gravelly clay. The substratum to a depth of 60 inches or more is reddish yellow very gravelly clay loam.

Included in this unit are small areas of moderately steep Pastura gravelly loam and Deama gravelly loam on back slopes, Disterheff soils on some south-facing side slopes of fan terraces, and Paymaster, Lynx, and Rune soils on alluvial fans and stream terraces. Included areas make up about 15 percent of the total acreage. The percentage varies from one area to another.

Permeability of this Showlow soil is slow. Available water capacity is high. Water supplying capacity is 10 to 13 inches. Effective rooting depth is 60 inches or more. Runoff is medium to rapid, and the hazard of water erosion is moderate to high. The hazard of soil blowing is slight.

This unit is used as grazable woodland and for firewood harvesting and wildlife habitat.

This unit is well suited to the production of Utah juniper, pinyon, and oneseed juniper. The average site index is 60. The unit can produce 7.5 cords per acre in a stand of trees that average 5 inches in diameter at a height of 1 foot.

Conventional methods of harvesting timber can be used. Management that minimizes the hazard of erosion is essential in harvesting firewood. Disturbed areas can be protected from erosion by seeding adapted plants. Plant competition delays natural regeneration but generally does not prevent the eventual development of a fully stocked, normal stand of trees. Brushy plants such as turbinella oak limit natural regeneration of Utah juniper. To maintain production of wood crops and forage, therefore, management may be needed to control turbinella oak.

This unit has moderate potential for production of understory forage. The preferred forage plants are blue grama, sideoats grama, bottlebrush squirreltail, and pinyon ricegrass. Thinning of dense stands of trees may be desirable where livestock grazing is the main use.

If the understory vegetation is poorly managed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases.

Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Planned grazing systems are essential to maintain plant vigor and forage production. Where a seed source is lacking in mismanaged areas or where competition from undesirable shrubby plants exists, desirable plants are slow to recover on this unit.

This unit is poorly suited to livestock watering ponds and other water impoundments because of slope. The included Rune soils are suited to this use.

Maintenance of snags with more than 40 percent bark is essential for birds that nest in cavities. Pinyon nut production is important for wildlife.

If this unit is used for homesite development, the main limitations are shrink-swell potential and slope. The effects of shrinking and swelling can be minimized by using proper engineering designs and by backfilling with material that has low shrink-swell potential.

If the unit is used for septic tank absorption fields, the main limitations are slow permeability and slope. Use of sandy backfill for the trench and long absorption lines helps to compensate for the slow permeability. Slope is a concern in installing septic tank absorption fields. Effluent from septic tank absorption fields can surface in downslope areas and thus create a hazard to health. Absorption lines should be installed on the contour.

This map unit is in capability subclass VIs.

43—Springerville cobbly clay, 0 to 8 percent slopes. This deep, well drained soil is on fan terraces and in basins. It formed in alluvium and colluvium derived dominantly from basalt and pyroclastics. Elevation is 5,500 to 5,800 feet. The average annual precipitation is 12 to 16 inches, the average annual air temperature is 50 to 54 degrees F, and the average frost-free period is 130 to 170 days.

Typically, the surface layer is brown cobbly clay 3 inches thick. The underlying material, to a depth of 42 inches, is dark reddish brown clay. Basalt is at a depth of 42 inches. Depth to basalt ranges from 40 to 60 inches.

Included in this unit are small areas of Ashfork, Cabezon, and Thunderbird soils in moderately sloping areas; other Springerville soils in basins; a soil, in basins, that is similar to this Springerville soil but has a layer of carbonate accumulation above the bedrock; and Rune soils on alluvial fans. Included areas make up about 15 percent of the total acreage. The percentage varies from one area to another.

Permeability of this Springerville soil is very slow. Available water capacity is medium. Water supplying capacity is 12 to 16 inches. Effective rooting depth is 40 to 60 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is slight.

This unit is used as rangeland and for wildlife habitat.

The potential plant community on this unit is mainly western wheatgrass, sideoats grama, blue grama, and vine-mesquite. If the range is poorly managed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Brush management improves deteriorated areas of range that are producing more woody shrubs than were present in the potential plant community. Mechanical treatment is not practical, because the surface is cobbly.

Suitable range management practices are fencing, implementing planned grazing systems, and developing water for livestock. Where a seed source is lacking in mismanaged areas or where competition from undesirable shrubby plants exists, desirable plants are slow to recover on this unit.

The unit is poorly suited to livestock watering ponds and other water impoundments because of depth to rock and slope. The included Rune soils are suited to this use.

Elk and deer use this unit as winter range. The grass cover on the unit provides protection for newborn pronghorn fawns.

If this unit is used for homesite development, the main limitation is shrink-swell potential. If buildings are constructed on the soil in this unit, properly designing foundations and footings and diverting runoff away from buildings help to prevent structural damage because of shrinking and swelling.

The use of the unit for septic tank absorption fields is limited by the depth to bedrock and very slow permeability. The limitation of very slow permeability can be overcome by increasing the size of the absorption field.

This map unit is in capability subclass VIs.

44—Springerville very stony clay, 0 to 8 percent slopes. This deep, well drained soil is on fan terraces and in basins. It formed in alluvium and colluvium derived dominantly from basalt and pyroclastics. Elevation is 5,900 to 6,400 feet. The average annual precipitation is 12 to 16 inches, the average annual air temperature is 50 to 54 degrees F, and the average frost-free period is 130 to 170 days.

Typically, the surface layer is brown very stony clay 3 inches thick. The underlying material, to a depth of 42 inches, is dark reddish brown clay. Basalt is at a depth of 42 inches. Depth to basalt ranges from 40 to 60 inches.

Included in this unit are small areas of Ashfork, Cabezon, and Thunderbird soils in moderately sloping areas, other Springerville soils in basins, a soil that is similar to this Springerville soil but has a layer of carbonate accumulation above the bedrock, and Rune soils on alluvial fans. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

Permeability of this Springerville soil is very slow. Available water capacity is medium. Water supplying

capacity is 12 to 16 inches. Effective rooting depth is 40 to 60 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is slight.

This unit is used as rangeland and for wildlife habitat.

The potential plant community on this unit is mainly western wheatgrass, sideoats grama, blue grama, and vine-mesquite. If the range is poorly managed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Brush management improves deteriorated areas of range that are producing more woody shrubs than were present in the potential plant community. Mechanical treatment is not practical because the surface is stony.

Management practices suitable for use on this unit are proper range use, deferred grazing, rotation grazing, and aerial spraying for brush management. Where a seed source is lacking in mismanaged areas or where competition from undesirable shrubby plants exists, desirable plants are slow to recover on this unit.

The unit is poorly suited to livestock watering ponds and other water impoundments because of depth to bedrock and slope. The included Rune soils are suited to this use.

Elk and deer use this unit as winter range. The grass cover on the unit provides protection for newborn pronghorn fawns.

If this unit is used for homesite development, the main limitation is shrink-swell potential. If buildings are constructed on the soil in this unit, properly designing foundations and footings and diverting runoff away from buildings help to prevent structural damage because of shrinking and swelling.

The use of the unit for septic tank absorption fields is limited by depth to bedrock and very slow permeability. The limitation of very slow permeability can be overcome by increasing the size of the absorption field.

This map unit is in capability subclass VIIs.

45—Tajo-Springerville complex, 0 to 15 percent slopes. This map unit is on fan terraces and in basins. Elevation is 5,000 to 6,000 feet. The average annual precipitation is 12 to 16 inches, the average annual air temperature is 50 to 54 degrees F, and the average frost-free period is 130 to 170 days.

This unit is 50 percent Tajo gravelly loam and 40 percent Springerville cobbly clay. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Ashfork, Cabezon, and Thunderbird soils in moderately sloping areas; gently sloping Apache, Cross, and Pastura soils on plateaus; and Rune soils on stream terraces. Included areas make up about 10 percent of the total acreage. The percentage varies from one area to another.

The Tajo soil is moderately deep and well drained. It formed in alluvium and colluvium derived dominantly from pyroclastics and basalt. Typically, the surface layer is brown gravelly loam 3 inches thick. The subsoil is brown clay loam 15 inches thick. The upper 6 inches of the substratum is brown gravelly clay loam. The next layer is a white, lime-cemented hardpan 6 inches thick. Below this is white very cobbly sandy loam 20 inches thick. Basalt is at a depth of 50 inches. Depth to the hardpan ranges from 20 to 40 inches.

Permeability of the Tajo soil is moderately slow. Available water capacity is low. Water supplying capacity is 11 to 14 inches. Effective rooting depth is 20 to 40 inches. Runoff is slow to medium, and the hazard of water erosion is slight to moderate. The hazard of soil blowing is slight.

The Springerville soil is deep and well drained. It formed in colluvium derived dominantly from basalt and pyroclastics. Typically, the surface layer is reddish brown cobbly clay 4 inches thick. The underlying material, to a depth of 42 inches, is dark reddish brown clay. Basalt is at a depth of 42 inches. Depth to basalt ranges from 40 to 60 inches.

Permeability of the Springerville soil is very slow. Available water capacity is medium. Water supplying capacity is 11 to 14 inches. Effective rooting depth is 40 to 60 inches. Runoff is slow to medium, and the hazard of water erosion is slight. The hazard of soil blowing is slight.

This unit is used as rangeland and for wildlife habitat.

The potential plant community on the Tajo soil is mainly blue grama, sideoats grama, black grama, and galleta. The production of forage is limited by the high content of lime in the soil. If the range is poorly managed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community.

The potential plant community on the Springerville soil is mainly western wheatgrass, sideoats grama, blue grama, and vine-mesquite. Management practices suitable for use on this soil are proper range use, deferred grazing, rotation grazing, and aerial spraying for brush management. Other suitable range management practices are fencing, implementing planned grazing systems, and developing water for livestock.

This unit is poorly suited to livestock watering ponds and other water impoundments because of the cemented pan of the Tajo soil, depth to bedrock, and slope. The included Rune soils are suited to this use.

Elk and deer use this unit as winter range. The grass cover on the unit provides protection for newborn pronghorn fawns.

If the Tajo soil is used for homesite development, the main limitations are slope and the cemented pan. Excavation for building sites is limited by the cemented pan.

The use of the Tajo soil for septic tank absorption fields is limited by the cemented pan and moderately

slow permeability. The suitability of the soil for absorption fields can be improved by ripping the hardpan to increase permeability and by increasing the size of the absorption field.

If the Springerville soil is used for homesite development, the main limitation is shrink-swell potential. If buildings are constructed on this soil, properly designing foundations and footings and diverting runoff away from buildings help to prevent structural damage because of shrinking and swelling.

The use of the Springerville soil for septic tank absorption fields is limited by the depth to bedrock and very slow permeability. The limitation of very slow permeability can be overcome by increasing the size of the absorption field.

This map unit is in capability subclass VIs.

46—Tenorio very gravelly sandy loam, 0 to 8 percent slopes. This deep, well drained soil is on old stream terraces. It formed in mixed alluvium. Elevation is 5,500 to 6,000 feet. The average annual precipitation is 12 to 14 inches, the average annual air temperature is 50 to 54 degrees F, and the average frost-free period is 130 to 170 days.

Typically, the surface layer is brown very gravelly sandy loam 3 inches thick. The upper 13 inches of the subsoil is brown and reddish brown gravelly clay loam. The lower 7 inches is yellowish red very gravelly loamy sand. The substratum to a depth of 60 inches or more is yellowish red extremely gravelly sand.

Included in this unit are small areas of gently sloping Clovis and Poley soils on fan terraces and Paymaster and Lynx soils on alluvial fans and low stream terraces. Included areas make up about 15 percent of the total acreage. The percentage varies from one area to another.

Permeability of this Tenorio soil is moderately slow to a depth of 16 inches and rapid below this depth. Available water capacity is very low. Water supplying capacity is 12 to 14 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is slight.

This unit is used mainly as rangeland and for wildlife habitat. It is also used as a source of sand and gravel.

The potential plant community on this unit is mainly blue grama, black grama, hairy grama, and galleta. If the range is poorly managed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Suitable range management practices are fencing, implementing planned grazing systems, and developing water for livestock.

This unit is limited for livestock watering ponds and other water impoundments because of seepage potential.

The grass cover on this unit provides protection for newborn pronghorn fawns. Burrowing animals use this unit more than most other units in the survey area.

This unit is well suited to homesite development. It has few limitations.

The use of the unit for septic tank absorption fields is limited by the hazard of seepage. Effluent from septic tank absorption fields is poorly filtered; thus, it contaminates the ground water causing a hazard to health.

This map unit is in capability subclass VIs.

47—Thunderbird-Cabezon complex, 2 to 30 percent slopes. This map unit is on hillsides. Elevation is 5,000 to 6,000 feet. The average annual precipitation is 12 to 16 inches, the average annual air temperature is 50 to 54 degrees F, and the average frost-free period is 130 to 170 days.

This unit is 50 percent Thunderbird very cobbly clay loam and 35 percent Cabezon stony clay loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Ashfork and Cross soils in moderately sloping areas, Boquillas and Seligman soils on broad ridges, Springerville soils in basins, and Rune soils on stream terraces. Included areas make up about 15 percent of the total acreage. The percentage varies from one area to another.

The Thunderbird soil is moderately deep and well drained. It formed in alluvium and colluvium derived dominantly from basalt and pyroclastics. Typically, the surface layer is grayish brown very cobbly clay loam 2 inches thick. The upper 4 inches of the subsoil is dark brown clay loam. The lower 18 inches is dark brown and brown clay. Basalt is at a depth of 24 inches. Depth to basalt ranges from 20 to 40 inches.

Permeability of the Thunderbird soil is slow. Available water capacity is medium. Water supplying capacity is 12 to 16 inches. Effective rooting depth is 20 to 40 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is slight.

The Cabezon soil is shallow and well drained. It formed in alluvium and colluvium derived dominantly from basalt and pyroclastics. Typically, the surface layer is dark brown stony clay loam 3 inches thick. The subsoil is brown gravelly clay about 12 inches thick. Basalt is at a depth of 15 inches. Depth to basalt ranges from 10 to 20 inches.

Permeability of the Cabezon soil is slow. Available water capacity is very low. Water supplying capacity is 11 to 14 inches. Effective rooting depth is 10 to 20 inches. Runoff is slow to medium, and the hazard of water erosion is slight to moderate. The hazard of soil blowing is slight.

This unit is used as grazable woodland and for firewood harvesting and wildlife habitat.

The Thunderbird soil is well suited to the production of Utah juniper. The average site index is 51. The soil can

produce 9 cords per acre in a stand of trees that average 5 inches in diameter at a height of 1 foot. The preferred forage plants on this soil are muttongrass, blue grama, and sideoats grama.

The Cabezon soil is well suited to the production of Utah juniper and pinyon. The average site index is 140. The soil can produce 19 cords per acre in a stand of trees that average 5 inches in diameter at a height of 1 foot. The preferred forage plants on this soil are sideoats grama, muttongrass, and blue grama.

Stones or cobbles on the soil surface limit the use of equipment in harvesting firewood. The clayey texture of the surface layer also limits the use of equipment during periods when the soil is wet.

This unit has low potential for production of understory forage. If the understory vegetation is poorly managed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community.

Planned grazing systems are essential to maintain plant vigor and forage production. Where a seed source is lacking in mismanaged areas or where competition from undesirable shrubby plants exists, desirable plants are slow to recover on this unit.

This unit is poorly suited to livestock watering ponds and other water impoundments because of depth to bedrock and slope. The included Rune soils are suited to this use.

Maintenance of snags with more than 40 percent bark is essential for birds that nest in cavities. Pinyon nut production is important for wildlife.

If the Thunderbird soil is used for homesite development, the main limitations are shrink-swell potential, depth to bedrock, and slope. The effects of shrinking and swelling can be minimized by using proper engineering designs and by backfilling with material that has low shrink-swell potential. Cuts needed to provide essentially level building sites can expose bedrock.

If this soil is used for septic tank absorption fields, the main limitations are slow permeability, depth to bedrock, and slope. Use of long absorption lines and sandy backfill for the trench helps to compensate for the limitations of slow permeability and depth to bedrock. Slope is a concern in installing septic tank absorption fields. Absorption lines should be installed on the contour.

If the Cabezon soil is used for homesite development, the main limitations are depth to bedrock, shrink-swell potential, and slope. Excavation for buildings and roads is limited by shallow depth to bedrock. Because removal of the bedrock to an adequate depth could be costly, consider the use of construction methods that do not require excavation. The effects of shrinking and swelling can be minimized by using proper engineering designs and by backfilling with material that has low shrink-swell potential.

If this soil is used for septic tank absorption fields, the main limitations are shallow depth to bedrock, slow permeability, and slope. Consider the use of holding tanks or evaporative beds.

This map unit is in capability subclass VIs.

48—Thunderbird-Rock outcrop complex, 30 to 60 percent slopes. This map unit is on hillsides and in long, narrow areas along slopes of mesas. An intermittent basalt escarpment forms the upper boundary of areas of the unit, and undulating foot slopes form the lower boundary. Elevation is 5,800 to 6,800 feet. The average annual precipitation is 12 to 16 inches, the average annual air temperature is 50 to 54 degrees F, and the average frost-free period is 130 to 170 days.

This unit is 50 percent Thunderbird extremely stony clay loam and 30 percent Rock outcrop.

Included in this unit are small areas of Springerville, Kopie, Deama, Disterheff, Aut, Ashfork, and Cabezon soils. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

The Thunderbird soil is moderately deep and well drained. It formed in alluvium and colluvium derived dominantly from basalt and pyroclastics. Typically, the surface layer is grayish brown extremely stony clay loam 2 inches thick. The upper 4 inches of the subsoil is dark brown clay loam. The lower 18 inches is brown and dark brown clay. Basalt is at a depth of 24 inches. Depth to basalt ranges from 20 to 40 inches.

Permeability of the Thunderbird soil is slow. Available water capacity is medium. Water supplying capacity is 11 to 14 inches. Effective rooting depth is 20 to 40 inches. Runoff is slow to medium, and the hazard of water erosion is slight to moderate. The hazard of soil blowing is slight.

Rock outcrop consists of exposed areas of basalt. The rock is very hard and requires blasting if removal is desired.

This unit is used as grazable woodland and for firewood harvesting and wildlife habitat.

The Thunderbird soil in this unit is well suited to the production of Utah juniper. The average site index is 51. The soil can produce 9 cords per acre in a stand of trees that average 5 inches in diameter at a height of 1 foot.

Stones or cobbles on the soil surface limit the use of equipment in harvesting; the clayey texture of the surface layer also limits the use of equipment during periods when the soil is wet. Conventional methods of harvesting timber are difficult to use because of slope.

The preferred forage plants on the Thunderbird soil are muttongrass, blue grama, and sideoats grama. The soil has low potential for production of understory forage.

If the understory vegetation is poorly managed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that

the desired balance of species is maintained in the plant community. Planned grazing systems are essential to maintain plant vigor and forage production. Where a seed source is lacking in mismanaged areas or where competition from undesirable shrubby plants exists, desirable plants are slow to recover on this soil.

The Thunderbird soil is limited for livestock watering ponds and other water impoundments because of slope and depth to bedrock.

Maintenance of snags with more than 40 percent bark is essential for birds that nest in cavities. Pinyon nut production is important for wildlife.

If the Thunderbird soil is used for homesite development, the main limitations are slope, shrink-swell potential, depth to bedrock, and large stones. Cuts needed to provide essentially level building sites can expose bedrock. If buildings are constructed on the soil, properly designing foundations and footings and diverting runoff away from buildings help to prevent structural damage because of shrinking and swelling.

If the soil in this unit is used for septic tank absorption fields, the main limitations are slope, depth to bedrock, and slow permeability. Consider the use of holding tanks or evaporative beds.

This map unit is in capability subclass VIIs.

49—Thunderbird-Springerville association, strongly sloping. This map unit is on hillsides and fan terraces. Slope is 2 to 30 percent. Elevation is 5,500 to 7,000 feet. The average annual precipitation is 12 to 16 inches, the average annual air temperature is 50 to 54 degrees F, and the average frost-free period is 130 to 170 days.

This unit is 60 percent Thunderbird very stony clay loam and 30 percent Springerville cobbly clay. The Thunderbird soil is mainly on the hillsides; slope is 8 to 30 percent. The Springerville soil is in depressional areas; slope is 2 to 8 percent.

Included in this unit are small areas of Cabezon, Cross, and Springerville soils, Thunderbird very cobbly clay loam, Rock outcrop of basalt, and Rune soils on alluvial fans. Included areas make up about 10 percent of the total acreage. The percentage varies from one area to another.

The Thunderbird soil is moderately deep and well drained. It formed in alluvium and colluvium derived dominantly from basalt and pyroclastics. Typically, the surface layer is grayish brown very stony clay loam 2 inches thick. The upper 4 inches of the subsoil is dark brown clay loam. The lower 18 inches is dark brown and brown clay. Basalt is at a depth of 24 inches. Depth to basalt ranges from 20 to 40 inches.

Permeability of the Thunderbird soil is slow. Available water capacity is medium. Water supplying capacity is 12 to 16 inches. Effective rooting depth is 20 to 40 inches. Runoff is slow to medium, and the hazard of water erosion is slight to moderate. The hazard of soil blowing is slight.

The Springerville soil is deep and well drained. It formed in alluvium and colluvium derived dominantly from basalt and pyroclastics. Typically, the surface layer is dark reddish brown cobbly clay 3 inches thick. The underlying material is dark reddish brown clay 39 inches thick. Basalt is at a depth of 42 inches. Depth to basalt ranges from 40 to 60 inches.

Permeability of the Springerville soil is very slow. Available water capacity is medium. Water supplying capacity is 12 to 16 inches. Effective rooting depth is 40 to 60 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is slight.

This unit is used as grazable woodland and for firewood harvesting and wildlife habitat.

The Thunderbird soil is well suited to the production of Utah juniper. The average site index is 51. This soil can produce 9 cords per acre in a stand of trees that average 5 inches in diameter at a height of 1 foot. The preferred forage plants on this soil are muttongrass, blue grama, and sideoats grama.

The Springerville soil is well suited to the production of Utah juniper, oneseed juniper, and pinyon. The average site index is 42. This soil can produce 5 cords per acre in a stand of trees that average 5 inches in diameter at a height of 1 foot. The preferred forage plants on this soil are pinyon ricegrass, blue grama, and sideoats grama.

Stones or cobbles on the soil surface limit the use of equipment in harvesting. The clayey texture of the surface layer also limits the use of equipment during periods when the soils in this unit are wet. Conventional methods of harvesting timber can be used. Management that minimizes the hazard of erosion is essential. Disturbed areas can be protected from erosion by seeding adapted plants. Shrinking and swelling of the soils may interfere with the establishment of seedlings.

The unit has moderate potential for production of understory forage. If the understory vegetation is poorly managed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Proper grazing use is essential to maintain the vigor and production of forage plants. Where a seed source is lacking in mismanaged areas or where competition from undesirable shrubby plants exists, desirable plants are slow to recover on this unit.

This unit is poorly suited to livestock watering ponds and other water impoundments because of depth to bedrock and slope. The included Rune soils are suited to this use.

Maintenance of snags with more than 40 percent bark is essential for birds that nest in cavities. Pinyon nut production is important for wildlife.

If this unit is used for homesite development, the main limitations are depth to bedrock, shrink-swell potential, and slope. The Thunderbird soil is also limited by slope. Cuts needed to provide essentially level building sites can expose bedrock. If buildings are constructed on the soils in this unit, properly designing foundations and

footings and diverting runoff away from buildings help to prevent structural damage because of shrinking and swelling.

If the unit is used for septic tank absorption fields, the main limitations are very slow and slow permeability, depth to bedrock, and slope. Use of long absorption lines and sandy backfill for the trench helps to compensate for the limitations of very slow and slow permeability and depth to bedrock. Slope is a concern in installing septic tank absorption fields in areas of the Thunderbird soil. Absorption lines should be installed on the contour.

This map unit is in capability subclass VIIs.

50—Torrifluvents, saline. These deep, somewhat poorly drained soils are on flood plains and in drainageways. The soils formed in alluvium derived dominantly from limestone, shale, and sandstone. Slope is 0 to 3 percent. Elevation is 4,200 to 4,500 feet. The average annual precipitation is 4 to 6 inches, the average annual air temperature is 53 to 57 degrees F, and the average frost-free period is 150 to 200 days.

These soils are fine textured to coarse textured. They are stratified.

Included in this unit are small areas of Ives, Navajo, and Tours soils.

This unit is used for wildlife habitat. The riparian vegetation on the unit provides food, cover, and nesting areas for wildlife.

These soils are subject to seasonal overflow. This severely limits the use of the soils for homesite development.

This map unit is in capability subclass VIIw.

51—Tours silty clay loam, 0 to 8 percent slopes. This deep, well drained soil is on alluvial fans and flood plains. It formed in alluvium derived dominantly from limestone, sandstone, and shale. Elevation is 4,800 to 5,600 feet. The average annual precipitation is 6 to 10 inches, the average annual air temperature is 52 to 55 degrees F, and the average frost-free period is 150 to 175 days.

Typically, the surface layer is light reddish brown silty clay loam 2 inches thick. The upper 8 inches of the underlying material is reddish brown sandy clay loam. The next 29 inches is reddish brown silty clay loam and silt loam. The lower part to a depth of 60 inches or more is reddish brown very fine sandy loam and silty clay loam.

Included in this unit are small areas of Ives sandy loam on alluvial fans, Navajo clay on flood plains and in basins, and an Epikom fine sandy loam that is underlain by shale remnants. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

Permeability of this Tours soil is moderately slow. Available water capacity is high. Water supplying capacity is 5 to 9 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is moderate. The hazard of soil blowing is moderate. This soil is subject to rare, brief periods of flooding in winter and spring.

This unit is used as rangeland and for wildlife habitat. It can be used for irrigated crops if water is made available.

The potential plant community on this unit is mainly alkali sacaton, galleta, blue grama, western wheatgrass, and fourwing saltbush. If the range is poorly managed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community.

If the plant cover is disturbed, protection from flooding is needed to control gullying, streambank cutting, and sheet erosion. Good accessibility, a large variety of palatable plants, and availability of water encourage a constant grazing pressure. Proper grazing use, range seeding, and a planned system of grazing are needed to maintain or improve the production of forage.

This unit is suited to livestock watering ponds and other water impoundments if proper construction techniques are used.

Use of this unit by wildlife is restricted mainly to the drainageways, which provide diverse vegetation suitable for food and cover. The grass cover on the unit provides protection for newborn pronghorn fawns.

If this unit is used for homesite development, the main limitation is the hazard of flooding. Roads and streets should be located above the expected flood level. Dikes and channels that have outlets for floodwater can be used to protect buildings and onsite sewage disposal systems from flooding.

The use of this unit for septic tank absorption fields is limited by the hazard of flooding and moderately slow permeability. The limitation of moderately slow permeability can be overcome by increasing the size of the absorption field.

This map unit is in capability subclass VIIc.

52—Tours-Ives association, gently sloping. This map unit is on alluvial fans and flood plains. Slope is 0 to 8 percent. Elevation is 4,400 to 5,900 feet. The average annual precipitation is 6 to 10 inches, the average annual air temperature is 52 to 55 degrees F, and the average frost-free period is 150 to 175 days.

This unit is 45 percent Tours fine sandy loam and 35 percent Ives sandy loam.

Included in this unit are small areas of Tours silty clay loam and Navajo clay on flood plains and in basins. Also included are small areas of Epikom fine sandy loam, Purgatory soils, and Rock outcrop of shale. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

The Tours soil is deep and well drained. It formed in alluvium derived dominantly from limestone, sandstone,

and shale. Typically, the surface layer is light reddish brown fine sandy loam 2 inches thick. The upper 8 inches of the underlying material is reddish brown sandy clay loam. The next 29 inches is reddish brown silty clay loam and silt loam. The lower part to a depth of 60 inches or more is reddish brown very fine sandy loam and silty clay loam.

Permeability of the Tours soil is moderately slow. Available water capacity is high. Water supplying capacity is 5 to 9 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is moderate. The hazard of soil blowing is high. This soil is subject to rare, brief periods of flooding in winter and spring.

The Ives soil is deep and well drained. It formed in alluvium derived dominantly from limestone, sandstone, and shale. Typically, the surface layer is reddish brown sandy loam 3 inches thick. The upper 35 inches of the underlying material is reddish brown fine sandy loam. The lower part to a depth of 60 inches or more is reddish brown sandy loam stratified with thin layers of fine sandy loam and gravelly sandy loam.

Permeability of the Ives soil is moderate. Available water capacity is high. Water supplying capacity is 5 to 9 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is moderate. The hazard of soil blowing is high. The soil is subject to rare, brief periods of flooding in winter and spring.

This unit is used as rangeland and for wildlife habitat. It can be used for irrigated crops if water is made available.

The potential plant community on the Tours soil is mainly alkali sacaton, western wheatgrass, blue grama, fourwing saltbush, and Indian ricegrass. The potential plant community on the Ives soil is mainly dropseed, blue grama, Indian ricegrass, and alkali sacaton. If the range is poorly managed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Livestock grazing should also be managed to protect the unit from excessive erosion.

The Tours soil is well suited to livestock watering ponds and other water impoundments. The Ives soil is poorly suited to this use because of the seepage potential.

Use of this unit by wildlife is restricted mainly to the drainageways, which provide diverse vegetation suitable for food and cover. The quality and quantity of browse on this unit encourage the concentration of big game animals, which compete with livestock for the diverse vegetation and water available on the unit. Deer use the unit as winter range. The grass cover on this unit provides protection for newborn pronghorn fawns.

If this unit is used for homesite development, the main limitation is the hazard of flooding. Dikes and channels that have outlets for floodwater can be used to protect buildings and onsite sewage disposal systems from flooding. Roads and streets should be located above the expected flood level.

The use of this unit for septic tank absorption fields is limited by moderately slow permeability of the Tours soil and the hazard of flooding. The limitation of moderately slow permeability can be overcome by increasing the size of the absorption field.

This map unit is in capability subclass VIIc.

53—Tovar complex, 2 to 25 percent slopes. This map unit is on hillsides. Elevation is 5,800 to 6,100 feet. The average annual precipitation is 14 to 16 inches, the average annual air temperature is 50 to 54 degrees F, and the average frost-free period is 130 to 170 days.

This unit is 60 percent Tovar very stony fine sandy loam and 25 percent Tovar fine sandy loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Disterheff soils on fan terraces; Paymaster, Lynx, and Rune soils on flood plains and alluvial fans; and Rock outcrop of sandstone on steep slopes adjacent to narrow drainageways. Included areas make up about 15 percent of the total acreage. The percentage varies from one area to another.

The Tovar very stony fine sandy loam is moderately deep and well drained. It formed in alluvium and colluvium derived dominantly from sandstone. Typically, the surface layer is reddish brown very stony fine sandy loam 3 inches thick. The upper 5 inches of the subsoil is reddish brown flaggy sandy clay loam. The lower 27 inches is red flaggy clay. Sandstone is at a depth of 35 inches. Depth to bedrock ranges from 20 to 40 inches.

Permeability of the Tovar very stony fine sandy loam is slow. Available water capacity is medium. Water supplying capacity is 14 to 16 inches. Effective rooting depth is 20 to 40 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is slight.

The Tovar fine sandy loam is moderately deep and well drained. It formed in alluvium and colluvium derived dominantly from sandstone. Typically, the surface layer is reddish brown fine sandy loam 3 inches thick. The upper 5 inches of the subsoil is brown flaggy sandy clay loam. The lower 27 inches is dark reddish brown, reddish brown, and yellowish red flaggy clay. Sandstone is at a depth of 35 inches. Depth to sandstone ranges from 20 to 40 inches.

Permeability of the Tovar fine sandy loam is slow. Available water capacity is medium. Water supplying capacity is 14 to 16 inches. Effective rooting depth is 20 to 40 inches. Runoff is slow, and the hazard of water erosion is slight to moderate. The hazard of soil blowing is high.

This unit is used as grazable woodland, for firewood harvesting, as a source of flagstones, and for wildlife habitat.

This unit is well suited to the production of Utah juniper and pinyon. The average site index is 45 for Utah juniper and 17 for pinyon. In a stand of trees that average 5 inches in diameter at a height of 1 foot, the unit can produce 7 cords per acre of Utah juniper and 2.5 cords per acre of pinyon. The preferred forage plants on this unit are sideoats grama, needleandthread, muttongrass, and blue grama.

Management that minimizes the hazard of erosion is essential in harvesting firewood. Disturbed areas can be protected from erosion by seeding adapted plants. Stones or cobbles on the soil surface limit the use of equipment in harvesting.

The unit has high potential for production of understory forage. Plant competition delays natural regeneration but generally does not prevent the eventual development of a fully stocked, normal stand of trees. Brushy plants such as turbinella oak limit natural regeneration of Utah juniper. To maintain production of wood crops and forage, therefore, management may be needed to control turbinella oak. Thinning of dense stands of trees may be desirable where livestock grazing is the main use.

If the understory vegetation is poorly managed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Planned grazing systems are essential to maintain plant vigor and forage production. Where a seed source is lacking in mismanaged areas or where competition from undesirable shrubby plants exists, desirable plants are slow to recover on this unit.

The unit is poorly suited to livestock watering ponds and other water impoundments because of depth to bedrock and slope. The included Rune soils are suited to this use.

Maintenance of snags with more than 40 percent bark is essential for birds that nest in cavities. Pinyon nut production is important for wildlife.

If this unit is used for homesite development, the main limitations are shrink-swell potential, depth to bedrock, large stones, and slope. Properly designing foundations and footings and diverting runoff away from buildings help to prevent structural damage because of shrinking and swelling. Cuts needed to provide essentially level building sites can expose bedrock.

If the unit is used for septic tank absorption fields, the main limitations are slow permeability, depth to bedrock, and slope. Use of long absorption lines and sandy backfill for the trench helps to compensate for the limitations of slow permeability and depth to bedrock. Slope is a concern in installing septic tank absorption fields. Absorption lines should be installed on the contour.

This map unit is in capability subclass VIIs.

54—Tovar complex, 25 to 60 percent slopes. This map unit is on hillsides. Elevation is 5,200 to 6,200 feet. The average annual precipitation is 14 to 16 inches, the average annual air temperature is 50 to 54 degrees F, and the average frost-free period is 130 to 170 days.

This unit is 60 percent Tovar extremely stony fine sandy loam and 25 percent Tovar fine sandy loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Disterheff soils on foot slopes; Paymaster, Lynx, and Rune soils on flood plains and alluvial fans; and Rock outcrop of sandstone. Included areas make up about 15 percent of the total acreage. The percentage varies from one area to another.

The Tovar extremely stony fine sandy loam is moderately deep and well drained. It formed in colluvium and alluvium derived dominantly from sandstone. Typically, the surface layer is reddish brown extremely stony fine sandy loam 3 inches thick. The upper 5 inches of the subsoil is brown flaggy sandy clay loam. The lower 27 inches is yellowish red flaggy clay. Sandstone is at a depth of 35 inches. Depth to sandstone ranges from 20 to 40 inches.

Permeability of the Tovar extremely stony fine sandy loam is slow. Available water capacity is medium. Water supplying capacity is 13 to 15 inches. Effective rooting depth is 20 to 40 inches. Runoff is medium to rapid, and the hazard of water erosion is slight. The hazard of soil blowing is slight.

The Tovar fine sandy loam is moderately deep and well drained. It formed in alluvium and colluvium derived dominantly from sandstone. Typically, the surface layer is reddish brown fine sandy loam 3 inches thick. The upper 5 inches of the subsoil is brown flaggy sandy clay loam. The lower 27 inches is reddish brown, yellowish red, and dark reddish brown flaggy clay. Sandstone is at a depth of 35 inches. Depth to sandstone ranges from 20 to 40 inches.

Permeability of the Tovar fine sandy loam is slow. Available water capacity is medium. Water supplying capacity is 13 to 15 inches. Effective rooting depth is 20 to 40 inches. Runoff is medium to rapid, and the hazard of water erosion is moderate to high. The hazard of soil blowing is high.

This unit is used as grazable woodland, for firewood harvesting, as a source of flagstones, and for wildlife habitat.

This unit is well suited to the production of Utah juniper and pinyon. The average site index is 45 for Utah juniper and 17 for pinyon. The unit can produce 7 cords per acre of Utah juniper and 2.5 cords per acre of pinyon in a stand of trees that average 5 inches in diameter at a height of 1 foot. The preferred forage plants on this unit are sideoats grama, needleandthread, muttongrass, and blue grama.

Stones or cobbles on the soil surface limit the use of equipment in harvesting. Conventional methods of harvesting timber are difficult to use because of slope. Management that minimizes the hazard of erosion is essential. Disturbed areas can be protected from erosion by seeding adapted plants. Plant competition delays natural regeneration but generally does not prevent the eventual development of a fully stocked, normal stand of trees. Brushy plants such as turbinella oak limit natural regeneration of Utah juniper. To maintain production of wood crops and forage, therefore, management may be needed to control turbinella oak.

The unit has high potential for production of understory forage. If the understory vegetation is poorly managed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Planned grazing systems are essential to maintain plant vigor and forage production. Where a seed source is lacking in mismanaged areas or where competition from undesirable shrubby plants exists, desirable plants are slow to recover on this unit.

The unit is poorly suited to livestock watering ponds and other water impoundments because of slope and depth to bedrock. The included Rune soils are suited to this use.

Maintenance of snags with more than 40 percent bark is essential for birds that nest in cavities. Pinyon nut production is important for wildlife. Rock outcrop provides nesting areas for birds of prey.

If this unit is used for homesite development, the main limitations are shrink-swell potential, depth to bedrock, slope, and large stones. Properly designing foundations and footings and diverting runoff away from buildings help to prevent structural damage because of shrinking and swelling. Cuts needed to provide essentially level building sites can expose bedrock.

If the unit is used for septic tank absorption fields, the main limitations are slow permeability, depth to bedrock, and slope. Use of long absorption lines and sandy backfill for the trench helps to compensate for the limitations of slow permeability and depth to bedrock. Slope is a concern in installing septic tank absorption fields. Absorption lines should be installed on the contour.

This map unit is in capability subclass VIIs.

55—Tusayan-Lynx association, gently sloping. This map unit is on plateaus and alluvial fans. Slope is 0 to 8 percent. Elevation is 5,600 to 6,000 feet. The average annual precipitation is 12 to 14 inches, the average annual air temperature is 52 to 54 degrees F, and the average frost-free period is 140 to 160 days.

This unit is 60 percent Tusayan gravelly loam and 30 percent Lynx loam. The Tusayan soil is in gently sloping to moderately sloping areas on plateaus, and the Lynx soil is in nearly level to gently sloping areas on alluvial fans.

Included in this unit are small areas of Boysag gravelly loam in depressional areas on plateaus, Winona gravelly loam and stony loam on ridges, and Paymaster sandy loam on alluvial fans. Included areas make up about 10 percent of the total acreage. The percentage varies from one area to another.

The Tusayan soil is moderately deep and well drained. It formed in alluvial and eolian deposits derived dominantly from limestone and calcareous sandstone. Typically, the surface layer is brown gravelly loam 3 inches thick. The subsurface layer is brown gravelly loam 7 inches thick. The upper 6 inches of the subsoil is light brownish gray gravelly loam. The lower 11 inches is brown extremely gravelly loam. The substratum is light brown very gravelly loam 2 inches thick over calcareous sandstone. Depth to sandstone ranges from 20 to 40 inches.

Permeability of the Tusayan soil is moderate. Available water capacity is very low. Water supplying capacity is 12 to 14 inches. Effective rooting depth is 20 to 40 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is slight.

The Lynx soil is deep and well drained. It formed in alluvium derived dominantly from basalt, limestone, sandstone, and quartzite. Typically, the surface layer is brown loam 2 inches thick. The subsurface layer is brown clay loam 34 inches thick. The underlying material to a depth of 60 inches or more is reddish brown clay loam. It has thin strata of finer textured or coarser textured material.

Permeability of the Lynx soil is moderately slow. Available water capacity is high. Water supplying capacity is 12 to 14 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is moderate. The hazard of soil blowing is slight. This soil is subject to rare, brief periods of flooding in winter and spring.

This unit is used as rangeland and for wildlife habitat. The Lynx soil can be used for irrigated crops if water is made available.

The potential plant community on the Tusayan soil is mainly black grama, blue grama, sideoats grama, needleandthread, and New Mexico feathergrass. The production of forage is limited by depth to bedrock, low available water capacity, and high content of lime. Planned grazing systems are essential to maintain plant vigor and forage production. Suitable range management practices are fencing, implementing planned grazing systems, and developing water for livestock.

The Tusayan soil is limited for livestock watering ponds and other water impoundments because of the seepage potential, depth to bedrock, and slope.

The potential plant community on the Lynx soil is mainly western wheatgrass, vine-mesquite, blue grama, and fourwing saltbush. If the range is poorly managed, the proportion of preferred forage plants decreases and

the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. If the plant cover is disturbed, protection from flooding is needed to control gullying, streambank cutting, and sheet erosion. Proper grazing use, range seeding, and a planned system of grazing are needed to maintain or improve the production of forage.

The Lynx soil is moderately limited for livestock watering ponds and other water impoundments because of slope.

Use of this unit by wildlife is restricted mainly to the drainageways, which provide diverse vegetation suitable for food and cover. The quality and quantity of browse on this unit encourage the concentration of big game animals, which compete with livestock for the diverse vegetation and water available on the unit. Elk and deer use this unit as winter range. The grass cover on the unit provides protection for newborn pronghorn fawns.

If the Tusayan soil is used for homesite development, the main limitation is depth to bedrock. Cuts needed to provide essentially level building sites can expose the bedrock. The use of this soil for septic tank absorption fields is also limited by depth to bedrock. Use of long absorption lines helps to compensate for this limitation.

If the Lynx soil is used for homesite development, the main limitations are shrink-swell potential and the hazard of flooding. The effects of shrinking and swelling can be minimized by using proper engineering designs and by backfilling with material that has low shrink-swell potential. Dikes and channels that have outlets for floodwater can be used to protect buildings and onsite sewage disposal systems from flooding.

The use of the Lynx soil for septic tank absorption fields is limited by moderately slow permeability and the hazard of flooding. The limitation of moderately slow permeability can be overcome by increasing the size of the absorption field.

This map unit is in capability subclass VIs.

56—Tuweep very gravelly loam, 0 to 15 percent slopes. This deep, well drained soil is on plateaus and mesas. It formed in alluvium derived dominantly from basalt and pyroclastics. Elevation is 4,800 to 5,800 feet. The average annual precipitation is 8 to 14 inches, the average annual air temperature is 52 to 55 degrees F, and the average frost-free period is 150 to 175 days.

Typically, the surface layer is pale brown very gravelly loam 3 inches thick. The subsoil is pale brown and light yellowish brown clay loam 13 inches thick. The upper 18 inches of the substratum is very pale brown clay loam. The lower part to a depth of 60 inches or more is light yellowish brown extremely stony loam.

Included in this unit are small areas of Apache soils, Aut gravelly loam, Rock outcrop of basalt, Cross soils, and Lomaki, Nalaki, Wukoki, and Wupatki very cindery loams. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

Permeability of this Tuweep soil is moderately slow. Available water capacity is high. Water supplying capacity is 8 to 14 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is slight.

This unit is used as rangeland and for wildlife habitat.

The potential plant community on this unit is mainly alkali sacaton, New Mexico feathergrass, black grama, and sideoats grama. If the range is poorly managed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Proper grazing use, range seeding, and a planned system of grazing are needed to maintain or improve the production of forage. Other suitable range management practices are fencing and developing livestock watering facilities.

The unit is limited for livestock watering ponds and other water impoundments because of seepage potential and slope.

Elk and deer use this unit as winter range.

If this unit is used for homesite development, the main limitations are shrink-swell potential and slope. The effects of shrinking and swelling can be minimized by using proper engineering designs and by backfilling with material that has low shrink-swell potential.

The use of this unit for septic tank absorption fields is limited by moderately slow permeability and slope. The limitation of moderately slow permeability can be overcome by increasing the size of the absorption field.

This map unit is in capability subclass VIs.

57—Valle gravelly silt loam, 0 to 8 percent slopes. This deep, well drained soil is on alluvial fans and stream terraces. It formed in alluvium derived dominantly from basalt and pyroclastics. Elevation is 6,900 to 7,200 feet. The average annual precipitation is 12 to 16 inches, the average annual air temperature is 49 to 52 degrees F, and the average frost-free period is 120 to 160 days.

Typically, the surface layer is brown gravelly silt loam 3 inches thick. The subsurface layer is brown gravelly loam 10 inches thick. The upper 15 inches of the underlying material is reddish brown gravelly loam. The lower part to a depth of 60 inches or more is reddish brown very gravelly clay loam.

Included in this unit are small areas of Aut gravelly loam on plateaus; Paymaster, Lynx, and Rune soils on alluvial fans and stream terraces; and Quivera very gravelly loam and Ziegler gravelly loam on fan terraces. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

Permeability of this Valle soil is moderate. Available water capacity is medium. Water supplying capacity is 14 to 18 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is moderate. The hazard of soil blowing is slight.

This unit is used as rangeland and for wildlife habitat.

The potential plant community on this unit is mainly blue grama, galleta, and needleandthread. If the range is poorly managed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Proper grazing use, range seeding, and a planned system of grazing are needed to maintain or improve the production of forage.

This unit is limited for livestock watering ponds and other water impoundments because of the seepage potential and slope.

This unit is well suited to homesite development. It has few limitations.

The use of this unit for septic tank absorption fields is limited by moderately slow permeability. This limitation can be overcome by increasing the size of the absorption field.

This map unit is in capability subclass VIc.

58—Wilaha cindery loam, 2 to 30 percent slopes. This deep, well drained soil is on fan terraces and hillsides. It formed in alluvium derived dominantly from pyroclastics and basalt. Elevation is 5,800 to 6,000 feet. The average annual precipitation is 12 to 16 inches, the average annual air temperature is 50 to 54 degrees F, and the average frost-free period is 130 to 170 days.

Typically, the surface layer is reddish brown cindery loam 5 inches thick. The upper 9 inches of the subsoil is reddish brown cindery clay loam. The lower 3 inches is pinkish gray very cindery loam. The substratum to a depth of 60 inches or more is cinders.

Included in this unit are small areas of Ziegler gravelly loam on toe slopes, Wukoki very cindery loam and eroded areas of exposed cinders on moderately steep side slopes, Aut and Cross soils on gently sloping side slopes, and Rock outcrop of basalt. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

Permeability of the Wilaha soil is moderately slow to a depth of 14 inches and rapid below this depth. Available water capacity is low. Water supplying capacity is 11 to 14 inches. Effective rooting depth is 60 inches or more. Runoff is slow to medium, and the hazard of water erosion is slight to moderate. The hazard of soil blowing is slight.

This unit is used as grazable woodland and for firewood harvesting and wildlife habitat. It is also used as a source of cinder gravel.

This unit is well suited to the production of pinyon, Utah juniper, and oneseed juniper. The average site index is 33. The unit can produce 3.5 cords per acre in a stand of trees that average 5 inches in diameter at a height of 1 foot. The preferred forage plants on this unit are blue grama, muttongrass, Mexican cliffrose, and skunkbush sumac.

Conventional methods of harvesting timber can be used. Management that minimizes the hazard of erosion is essential. Disturbed areas can be protected from erosion by seeding adapted plants.

This unit has moderate potential for production of understory forage. If the understory vegetation is poorly managed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Proper grazing use is essential to maintain the vigor and production of forage plants. Where a seed source is lacking in mismanaged areas or where competition from undesirable shrubby plants exists, desirable plants are slow to recover on this unit.

The unit is limited for livestock watering ponds and other water impoundments because of seepage potential and slope.

Maintenance of snags with more than 40 percent bark is essential for birds that nest in cavities. Pinyon nut production is important for wildlife.

If this unit is used for homesite development, the main limitations are slope and restricted load supporting capacity. The soil in this unit is susceptible to settling if structures are built on it. Settlement can be minimized by compacting the soil. Access roads should be designed to control surface runoff and help stabilize cut slopes.

If the unit is used for septic tank absorption fields, the main limitations are slope and seepage potential. Effluent from septic tank absorption fields can surface in downslope areas and thus create a hazard to health. Because effluent is poorly filtered by the cinders, it can also contaminate the ground water. Slope is a concern in installing septic tank absorption fields. Absorption lines should be installed on the contour.

This map unit is in capability subclass VIs.

59—Wilaha-Wukoki association, steep. This map unit is on hillsides. Slope is 30 to 60 percent. Elevation is 6,600 to 7,200 feet. The average annual precipitation is 12 to 16 inches, the average annual air temperature is 49 to 52 degrees F, and the average frost-free period is 120 to 160 days.

This unit is 50 percent Wilaha cindery loam and 40 percent Wukoki very cindery loam. The Wilaha soil is mostly on the lower parts of slopes, but a few areas are on the steeper parts. The Wukoki soil is on the steeper parts of slopes.

Included in this unit are small areas of Ziegler gravelly loam on toe slopes, eroded areas of exposed cinders on steep side slopes, and exposed basalt plugs in cinder vents. Included areas make up about 10 percent of the total acreage. The percentage varies from one area to another.

The Wilaha soil is deep and well drained. It formed in alluvium derived dominantly from pyroclastics and basalt. Typically, the surface layer is reddish brown cindery loam

5 inches thick. The upper 9 inches of the subsoil is reddish brown cindery clay loam. The lower 3 inches is pinkish gray very cindery loam. The substratum to a depth of 60 inches or more is gray cinders.

Permeability of the Wilaha soil is moderately slow to a depth of 17 inches and rapid below this depth. Available water capacity is low. Water supplying capacity is 13 to 16 inches. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is slight.

The Wukoki soil is deep and well drained. It formed in pyroclastics. Typically, the surface layer is brown very cindery loam 10 inches thick. The upper 5 inches of the subsoil is pale brown very cindery loam. The lower 3 inches is light yellowish brown extremely cindery loam. The substratum to a depth of 60 inches or more is dark gray cinders.

Permeability of the Wukoki soil is moderate to a depth of 18 inches and rapid below this depth. Available water capacity is low. Water supplying capacity is 13 to 16 inches. Effective rooting depth is 60 inches or more. Runoff is slow to medium, and the hazard of water erosion is slight to moderate. The hazard of soil blowing is slight.

This unit is used mainly for livestock grazing and wildlife habitat and as a source of cinder gravel. The Wilaha soil is suitable for use as woodland.

The Wilaha soil is well suited to the production of pinyon, Utah juniper, and oneseed juniper. The average site index is 33. The soil can produce 3.5 cords per acre in a stand of trees that average 5 inches in diameter at a height of 1 foot. The preferred forage plants on this soil are blue grama, muttongrass, Mexican cliffrose, and skunkbush sumac.

Conventional methods of harvesting timber are difficult to use because of slope. Management that minimizes the hazard of erosion is essential. Disturbed areas can be protected from erosion by seeding adapted plants.

The Wilaha soil has moderate potential for production of understory forage. If the understory vegetation is poorly managed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Proper grazing use is essential to maintain the vigor and production of forage plants. Where a seed source is lacking in mismanaged areas or where competition from undesirable shrubby plants exists, desirable plants are slow to recover on this unit.

The potential plant community on the Wukoki soil is mainly black grama, blue grama, galleta, and sideoats grama. The production of forage is limited by steep to very steep slopes and low available water capacity. Slope limits access by livestock and results in overgrazing of the less sloping areas. Trails or walkways can be constructed in places to encourage livestock to graze in areas where access is limited.

The unit is limited for livestock watering ponds and other water impoundments because of the seepage potential and slope.

Maintenance of snags with more than 40 percent bark is essential for birds that nest in cavities. Pinyon nut production is important for wildlife.

If this unit is used for homesite development, the main limitations are slope and restricted load supporting capacity. The soils in the unit are susceptible to settling if structures are built on them. Settlement can be minimized by compacting the soils. Access roads should be designed to control surface runoff and help stabilize cut slopes.

If the unit is used for septic tank absorption fields, the main limitations are seepage potential and slope. Effluent from septic tank absorption fields can surface in downslope areas and thus create a hazard to health. Because effluent is poorly filtered by the cinders, it can also contaminate the ground water. Slope is a concern in installing septic tank absorption fields. Absorption lines should be installed on the contour.

This map unit is in capability subclass VIIe.

60—Winona gravelly loam, 0 to 8 percent slopes. This very shallow and shallow, well drained soil is on plateaus and mesas. It formed in alluvial and eolian deposits derived dominantly from limestone and calcareous sandstone. Elevation is 5,000 to 6,200 feet. The average annual precipitation is 8 to 12 inches, the average annual air temperature is 50 to 54 degrees F, and the average frost-free period is 130 to 175 days.

Typically, the surface layer is brown gravelly loam 2 inches thick. The underlying material, to a depth of 15 inches, is light yellowish brown extremely cobbly loam. Limestone is at a depth of 15 inches. Depth to limestone ranges from 6 to 20 inches.

Included in this unit are small areas of Boysag gravelly loam in concave areas; other Winona soils in convex areas and on ridges; Paymaster and Lynx soils on alluvial fans and stream terraces; Tusayan gravelly loam on mesas; and Rock outcrop on side slopes adjacent to drainageways. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

Permeability of this Winona soil is moderate. Available water capacity is very low. Water supplying capacity is 8 to 12 inches. Effective rooting depth is 6 to 20 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is slight.

This unit is used as rangeland and for wildlife habitat.

The potential plant community on this unit is mainly black grama, blue grama, sideoats grama, needleandthread, and Bigelow sagebrush. The production of forage is limited by depth to rock, very low available water capacity, and high content of lime. If the range is poorly managed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock

grazing should be managed so that the desired balance of species is maintained in the plant community.

Where a seed source is lacking in mismanaged areas or where competition from undesirable shrubby plants exists, desirable plants are slow to recover on this unit. Suitable range management practices are fencing, implementing planned grazing systems, and developing water for livestock.

This unit is poorly suited to livestock watering ponds and other water impoundments because of depth to bedrock. The included Lynx soils are suited to this use.

Elk and deer use this unit as winter range.

If this unit is used for homesite development, the main limitations are depth to bedrock and large stones. Excavation for buildings and roads is limited by very shallow and shallow depth to bedrock. Because removal of the bedrock to an adequate depth could be costly, consider the use of construction methods that do not require excavation.

The use of the unit for septic tank absorption fields is limited by the very shallow and shallow depth to bedrock. Consider the use of holding tanks or evaporative beds.

This map unit is in capability subclass VIs.

61—Winona stony loam, 0 to 8 percent slopes. This very shallow and shallow, well drained soil is on plateaus and mesas. It formed in alluvial and eolian deposits derived dominantly from limestone and calcareous sandstone. Elevation is 5,000 to 6,100 feet. The average annual precipitation is 8 to 12 inches, the average annual air temperature is 50 to 54 degrees F, and the average frost-free period is 130 to 175 days.

Typically, the surface layer is brown stony loam 2 inches thick. The underlying material, to a depth of 15 inches, is light yellowish brown extremely cobbly loam. Limestone is at a depth of 15 inches. Depth to limestone ranges from 6 to 20 inches.

Included in this unit are small areas of other Winona soils, Boysag gravelly loam in concave areas, Tusayan gravelly loam on alluvial and colluvial fans, Paymaster and Lynx soils on alluvial fans and stream terraces, and Rock outcrop of limestone on steep side slopes adjacent to drainageways. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

Permeability of this Winona soil is moderate. Available water capacity is very low. Water supplying capacity is 8 to 12 inches. Effective rooting depth is 6 to 20 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is slight.

This unit is used as rangeland and for wildlife habitat.

The potential plant community on this unit is mainly black grama, blue grama, sideoats grama, needleandthread, and Bigelow sagebrush. The production of forage is limited by depth to bedrock, very low available water capacity, and high content of lime. If the range is poorly managed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community.

Where a seed source is lacking in mismanaged areas or where competition from undesirable shrubby plants exists, desirable plants are slow to recover on this unit. Suitable range management practices are fencing, implementing planned grazing systems, and developing water for livestock.

This unit is poorly suited to livestock watering ponds and other water impoundments because of depth to bedrock. The included Lynx soils are suited to this use.

Elk and deer use this unit as winter range.

If this unit is used for homesite development, the main limitations are depth to bedrock and large stones. Excavation for buildings and roads is limited by very shallow and shallow depth to bedrock. Because removal of the bedrock to an adequate depth could be costly, consider the use of construction methods that do not require excavation.

The use of this unit for septic tank absorption fields is limited by the very shallow and shallow depth to bedrock and large stones. Consider the use of holding tanks or evaporative beds.

This map unit is in capability subclass VIIs.

62—Winona-Boysag gravelly loams, 0 to 8 percent slopes. This map unit is on plateaus and mesas. Elevation is 5,000 to 6,000 feet. The average annual precipitation is 12 to 14 inches, the average annual air temperature is 50 to 54 degrees F, and the average frost-free period is 130 to 175 days.

This unit is 55 percent Winona gravelly loam and 30 percent Boysag gravelly loam. The Winona soil is in convex areas, and the Boysag soil is in concave areas. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Kopie soils, Winona stony loam, and Rock outcrop on ridges; Paymaster and Lynx soils on alluvial fans and stream terraces; and Poley and Tusayan soils on foot slopes. Included areas make up about 15 percent of the total acreage. The percentage varies from one area to another.

The Winona soil is very shallow and shallow and is well drained. It formed in alluvial and eolian deposits derived dominantly from limestone and calcareous sandstone. Typically, the surface layer is brown gravelly loam 2 inches thick. The underlying material, to a depth of 15 inches, is light yellowish brown extremely cobbly loam. Limestone is at a depth of 15 inches. Depth to limestone ranges from 6 to 20 inches.

Permeability of the Winona soil is moderate. Available water capacity is very low. Water supplying capacity is 12 to 14 inches. Effective rooting depth is 6 to 20 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is slight.

The Boysag soil is shallow and well drained. It formed in alluvial and eolian deposits derived dominantly from limestone and calcareous sandstone. Typically, the surface layer is reddish brown gravelly loam 3 inches thick. The upper 2 inches of the subsoil is reddish brown gravelly clay loam. The lower 8 inches is yellowish red clay. The substratum is pinkish white very cobbly loam 3 inches thick. Limestone is at a depth of 16 inches. Depth to limestone ranges from 10 to 20 inches.

Permeability of the Boysag soil is slow. Available water capacity is very low. Water supplying capacity is 12 to 14 inches. Effective rooting depth is 10 to 20 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is slight.

This unit is used as rangeland and for wildlife habitat.

The potential plant community on this unit is mainly blue grama, black grama, needleandthread, and sideoats grama. The production of forage is limited by shallow depth to bedrock and very low available water capacity. If the range is poorly managed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community.

Management practices suitable for use on this unit are proper range use, deferred grazing, rotation grazing, and aerial spraying for brush management. Planned grazing systems are essential to maintain plant vigor and forage production. Where a seed source is lacking in mismanaged areas or where competition from undesirable shrubby plants exists, desirable plants are slow to recover on this unit.

The unit is poorly suited to livestock watering ponds and other water impoundments because of depth to bedrock. The included Lynx soils are suited to this use.

Elk and deer use this unit as winter range. Included areas of Rock outcrop provide nesting areas for birds of prey.

If this unit is used for homesite development, the main limitation is depth to bedrock. Excavation for buildings and roads is limited by very shallow and shallow depth to bedrock. Because removal of the bedrock to an adequate depth could be costly, consider the use of construction methods that do not require excavation.

The use of the unit for septic tank absorption fields is limited by the very shallow and shallow depth to bedrock. Consider the use of holding tanks or evaporative beds.

This map unit is in capability subclass VIs.

63—Winona-Epikom association, gently sloping. This map unit is on plateaus and mesas. Slope is 2 to 8 percent. Elevation is 5,000 to 5,800 feet. The average annual precipitation is 8 to 10 inches, the average annual air temperature is 52 to 54 degrees F, and the average frost-free period is 130 to 175 days.

This unit is 50 percent Winona stony sandy loam and 40 percent Epikom fine sandy loam.

Included in this unit are small areas of Tours silty clay loam on flood plains and Epikom gravelly fine sandy loam and rounded outcroppings of calcareous sandstone on erosional remnants. Included areas make up about 10 percent of the total acreage. The percentage varies from one area to another.

The Winona soil is very shallow and shallow and is well drained. It formed in alluvial and eolian deposits derived dominantly from limestone and calcareous sandstone. Typically, the surface layer is brown stony sandy loam 2 inches thick. The underlying material, to a depth of 15 inches, is yellowish brown and light yellowish brown extremely cobbly loam. Limestone is at a depth of 15 inches. Depth to limestone ranges from 6 to 20 inches.

Permeability of the Winona soil is moderate. Available water capacity is very low. Water supplying capacity is 8 to 12 inches. Effective rooting depth is 6 to 20 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is slight.

The Epikom soil is shallow and is well drained. It formed in alluvial and eolian deposits derived dominantly from sandy shale and sandstone. Typically, the surface layer is reddish brown fine sandy loam 3 inches thick. The subsoil, to a depth of 15 inches, is reddish yellow gravelly loam. Sandstone is at a depth of 15 inches. Depth to sandstone ranges from 10 to 20 inches.

Permeability of the Epikom soil is moderate. Available water capacity is very low. Water supplying capacity is 7 to 11 inches. Effective rooting depth is 10 to 20 inches. Runoff is slow, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

This unit is used as rangeland and for wildlife habitat.

The potential plant community on this unit is mainly sideoats grama, black grama, blue grama, and needleandthread. The production of forage is limited by depth to bedrock, very low available water capacity, and in the Winona soil, a high content of lime.

If the range is poorly managed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Where a seed source is lacking in mismanaged areas or where competition from undesirable shrubby plants exists, desirable plants are slow to recover on this unit. Suitable range management practices are fencing, implementing planned grazing systems, and developing water for livestock.

The unit is poorly suited to livestock watering ponds and other water impoundments because of depth to bedrock. The included Tours soil is suited to this use.

The included outcroppings of sandstone provide nesting areas for birds of prey.

If this unit is used for homesite development, the main limitations are depth to bedrock and large stones. Excavation for buildings and roads is limited by very shallow and shallow depth to bedrock. Because removal

of the bedrock to an adequate depth could be costly, consider the use of construction methods that do not require excavation.

The use of the unit for septic tank absorption fields is limited by the very shallow and shallow depth to bedrock and large stones. Consider the use of holding tanks or evaporative beds.

This map unit is in capability subclass VIIs.

64—Winona-Rock outcrop complex, 15 to 30 percent slopes. This map unit is on plateaus and mesas. Elevation is 5,300 to 6,100 feet. The average annual precipitation is 8 to 12 inches, the average annual air temperature is 50 to 54 degrees F, and the average frost-free period is 130 to 175 days.

This unit is 60 percent Winona gravelly loam and 30 percent Rock outcrop. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Boysag gravelly loam in concave areas, other Winona soils and Tusayan gravelly loam on strongly sloping side slopes, and Paymaster and Lynx soils on alluvial fans and stream terraces. Included areas make up about 10 percent of the total acreage. The percentage varies from one area to another.

The Winona soil is very shallow and shallow and is well drained. It formed in alluvial and eolian deposits derived dominantly from limestone and calcareous sandstone. Typically, the surface layer is brown gravelly loam 2 inches thick. The underlying material, to a depth of 15 inches, is yellowish brown and light yellowish brown extremely cobbly loam. Limestone is at a depth of 15 inches. Depth to limestone ranges from 6 to 20 inches.

Permeability of the Winona soil is moderate. Available water capacity is very low. Water supplying capacity is 6 to 10 inches. Effective rooting depth is 6 to 20 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is slight.

Rock outcrop consists of exposed areas of limestone and calcareous sandstone.

This unit is used as rangeland and for wildlife habitat.

The potential plant community on this unit is mainly black grama, blue grama, sideoats grama, needleandthread, and Bigelow sagebrush. The production of forage is limited by depth to bedrock, very low available water capacity, high content of lime, and slope. Mechanical treatment is not practical because of areas of Rock outcrop and steep slopes. Where a seed source is lacking in mismanaged areas or where competition from undesirable shrubby plants exists, desirable plants are slow to recover on this unit. Suitable range management practices are fencing, implementing planned grazing systems, and developing water for livestock.

The unit is poorly suited to livestock watering ponds and other water impoundments because of depth to bedrock and slope. The included Lynx soils are suited to this use.

Elk and deer use this unit as winter range. Rock outcrop provides nesting areas for birds of prey.

If this unit is used for homesite development, the main limitations are depth to bedrock and slope. Excavation for buildings and roads is limited by very shallow and shallow depth to bedrock. Because removal of the bedrock to an adequate depth could be costly, consider the use of construction methods that do not require excavation.

If the soil in this unit is used for septic tank absorption fields, the main limitations are very shallow and shallow depth to bedrock, slope, and stones and cobbles in the profile. Consider the use of holding tanks or evaporative beds.

This map unit is in capability subclass VIs.

65—Winona-Rock outcrop complex, 30 to 70 percent slopes. This map unit is on hillsides. Elevation is 4,800 to 6,100 feet. The average annual precipitation is 10 to 12 inches, the average annual air temperature is 50 to 54 degrees F, and the average frost-free period is 130 to 175 days.

This unit is 60 percent Winona gravelly loam and 30 percent Rock outcrop. The unit consists of a series of limestone ledges and intervening areas of Winona soils. Common short, intermittent, *V*-shaped drainageways intersect the major drainageways on the valley floor. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Boysag gravelly loam in small depressional areas, Tusayan gravelly loam on mesas, and Paymaster and Lynx soils on alluvial fans and flood plains on the valley floor. Included areas make up about 10 percent of the total acreage. The percentage varies from one area to another.

The Winona soil is very shallow and shallow and is well drained. It formed in alluvial and eolian deposits derived dominantly from limestone and calcareous sandstone. Typically, the surface layer is brown gravelly loam 2 inches thick. The underlying material, to a depth of 15 inches, is yellowish brown and light yellowish brown extremely cobbly loam. Limestone is at a depth of 15 inches. Depth to limestone ranges from 6 to 20 inches.

Permeability of the Winona soil is moderate. Available water capacity is very low. Water supplying capacity is 6 to 7 inches. Effective rooting depth is 6 to 20 inches. Runoff is rapid, and the hazard of water erosion is high. The hazard of soil blowing is slight.

Rock outcrop consists of exposed areas of limestone and calcareous sandstone.

This unit is used mainly for wildlife habitat. It is also used for livestock grazing.

The potential plant community on this unit is mainly black grama, blue grama, sideoats grama,

needleandthread, and Bigelow sagebrush. The production of forage is limited by depth to bedrock, slope, very low available water capacity, and high content of lime. Slope limits access by livestock and results in overgrazing of the less sloping areas. Cattle usually avoid areas of this unit unless their movement is restricted by fences.

The unit is poorly suited to livestock watering ponds and other water impoundments because of depth to bedrock and slope. The included Lynx soils are suited to this use.

Rock outcrop provides nesting areas for birds of prey.

If this unit is used for homesite development, the main limitations are depth to bedrock and slope. Excavation for buildings and roads is limited by very shallow and shallow depth to bedrock. Because removal of the bedrock to an adequate depth could be costly, consider the use of construction methods that do not require excavation.

If the unit is used for septic tank absorption fields, the main limitations are the very shallow and shallow depth to bedrock, slope, and cobbles in the profile. Consider the use of holding tanks or evaporative beds.

This map unit is in capability subclass VIIs.

66—Winona-Tusayan association, gently sloping. This map unit is on plateaus and mesas. Slope is 0 to 8 percent. Elevation is 5,200 to 6,000 feet. The average annual precipitation is 10 to 14 inches, the average annual air temperature is 50 to 54 degrees F, and the average frost-free period is 130 to 175 days.

This unit is 50 percent Winona gravelly sandy loam and 40 percent Tusayan gravelly sandy loam. The Winona soil has slopes of 0 to 8 percent, and the Tusayan soil has slopes of predominantly 0 to 3 percent.

Included in this unit are small areas of Paymaster and Lynx soils on alluvial fans and stream terraces, Winona stony loam on plains, and Rock outcrop in steep areas adjacent to drainageways. Included areas make up about 10 percent of the total acreage. The percentage varies from one area to another.

The Winona soil is very shallow and shallow and is well drained. It formed in alluvial and eolian deposits derived dominantly from limestone and calcareous sandstone. Typically, the surface layer is brown gravelly sandy loam 2 inches thick. The underlying material, to a depth of 15 inches, is yellowish brown and light yellowish brown extremely cobbly loam. Limestone is at a depth of 15 inches. Depth to limestone ranges from 6 to 20 inches.

Permeability of the Winona soil is moderate. Available water capacity is very low. Water supplying capacity is 10 to 14 inches. Effective rooting depth is 6 to 20 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is slight.

The Tusayan soil is moderately deep and well drained. It formed in alluvial and eolian deposits derived dominantly from limestone and calcareous sandstone. Typically, the surface layer is brown gravelly sandy loam 3 inches thick. The next layer is brown gravelly loam 7 inches thick. The upper 6 inches of the subsoil is light brownish gray very gravelly loam. The lower 11 inches is brown extremely gravelly loam. The substratum is light brown very gravelly loam 2 inches thick. Calcareous sandstone is at a depth of 29 inches. Depth to sandstone ranges from 20 to 40 inches.

Permeability of the Tusayan soil is moderate. Available water capacity is very low. Water supplying capacity is 10 to 14 inches. Effective rooting depth is 20 to 40 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is slight.

This unit is used as rangeland and for wildlife habitat.

The potential plant community on this unit is mainly black grama, blue grama, sideoats grama, and needleandthread. The production of forage is limited by depth to bedrock, very low available water capacity, and high content of lime. If the range is poorly managed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Suitable range management practices are fencing, implementing planned grazing systems, and developing water for livestock.

The unit is poorly suited to livestock watering ponds and other water impoundments because of depth to bedrock. The Tusayan soil is also limited by seepage potential. The included Lynx soils are suited to this use.

Elk and deer use this unit as winter range.

If the Winona soil is used for homesite development, the main limitation is depth to bedrock. Excavation for buildings and roads is limited by very shallow and shallow depth to bedrock. Because removal of the bedrock to an adequate depth could be costly, consider the use of construction methods that do not require excavation. The use of this soil for septic tank absorption fields is limited by the very shallow and shallow depth to bedrock. Consider the use of holding tanks or evaporative beds.

If the Tusayan soil is used for homesite development, the main limitation is depth to bedrock. Cuts needed to provide essentially level building sites can expose bedrock. The use of this soil for septic tank absorption fields is limited by depth to bedrock. Increasing the size of the absorption field helps to compensate for this limitation.

This map unit is in capability subclass VIs.

67—Wukoki-Rock outcrop complex, 5 to 25 percent slopes. This map unit is on fan terraces and hillsides. Elevation is 4,800 to 6,000 feet. The average annual precipitation is 8 to 14 inches, the average annual air temperature is 52 to 55 degrees F, and the average frost-free period is 150 to 175 days.

This unit is 70 percent Wukoki very cindery loam and 25 percent Rock outcrop. The components of this unit

are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of gently sloping Lomaki, Nalaki, and Wupatki soils on fan terraces and moderately sloping Tuweep soils on plateaus. Included areas make up about 5 percent of the total acreage. The percentage varies from one area to another.

The Wukoki soil is deep and well drained. It formed in pyroclastics. Typically, the surface layer is brown very cindery loam 10 inches thick. The subsoil is pale brown and light yellowish brown very cindery loam 8 inches thick. The substratum to a depth of 60 inches or more is dark gray cinders.

Permeability of the Wukoki soil is moderate to a depth of 18 inches and rapid below this depth. Available water capacity is very low. Water supplying capacity is 8 to 14 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is slight.

Rock outcrop consists of exposed areas of basalt.

This unit is used mainly as rangeland and for wildlife habitat. It is also used as a source of cinder gravel.

The potential plant community on this unit is mainly black grama, blue grama, galleta, and sideoats grama. If the range is poorly managed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community.

Slope limits access by livestock and results in overgrazing of the less sloping areas. Livestock grazing should be managed to protect the unit from excessive erosion. Suitable range management practices are fencing, implementing planned grazing systems, and developing water for livestock.

The unit is poorly suited to livestock watering ponds and other water impoundments because of seepage potential and slope.

Rock outcrop provides nesting areas for birds of prey. Elk and deer use this unit as winter range. The grass cover on the unit provides protection for newborn pronghorn fawns.

If this unit is used for homesite development, the main limitation is slope. Access roads should be designed to control surface runoff and help stabilize cut slopes. Cutbanks are not stable and are subject to slumping. The soil in this unit is susceptible to settling if structures are built on it. Settlement can be minimized by compacting the soil.

The use of the unit for septic tank absorption fields is limited by seepage potential and slope. Effluent from septic tank absorption fields can surface in downslope areas and thus create a hazard to health. Because effluent is poorly filtered by the cinders, it can also contaminate the ground water. Slope is a concern in installing septic tank absorption fields. Absorption lines should be installed on the contour.

This map unit is in capability subclass VIs.

68—Wukoki-Wupatki very cindery loams, 15 to 60 percent slopes. This map unit is on hillsides. Slope is dominantly 15 to 20 percent. Elevation is 5,200 to 6,800 feet. The average annual precipitation is 8 to 14 inches, the average annual air temperature is 52 to 55 degrees F, and the average frost-free period is 150 to 175 days.

This unit is 45 percent Wukoki very cindery loam and 35 percent Wupatki very cindery loam. The Wukoki soil has slopes of 15 to 60 percent, and the Wupatki soil has slopes of 15 to 20 percent. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Lomaki very cindery loam, Nalaki very cindery loam, and Rock outcrop. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

The Wukoki soil is deep and well drained. It formed in pyroclastics. Typically, the surface layer is brown very cindery loam 10 inches thick. The subsoil is pale brown and light yellowish brown very cindery loam 8 inches thick. The substratum to a depth of 60 inches or more is dark gray cinders.

Permeability of the Wukoki soil is moderate to a depth of 18 inches and rapid below this depth. Available water capacity is low. Water supplying capacity is 7 to 12 inches. Effective rooting depth is 60 inches or more. Runoff is slow to medium, and the hazard of water erosion is slight to moderate. The hazard of soil blowing is slight.

The Wupatki soil is very shallow and shallow and is well drained. It formed in pyroclastics. Typically, the surface layer is grayish brown very cindery loam 6 inches thick. The subsoil is grayish brown very cindery loam 10 inches thick. The next layer is a silica- and lime-cemented hardpan 4 inches thick. Below this to a depth of 60 inches or more is very dark gray cinders.

Permeability of the Wupatki soil is moderate. Available water capacity is very low. Water supplying capacity is 7 to 12 inches. Effective rooting depth is 8 to 20 inches. Runoff is slow to medium, and the hazard of water erosion is slight to moderate. The hazard of soil blowing is slight. Ripping and shattering the hardpan increase the effective rooting depth and improve internal drainage. drainage.

This unit is used as rangeland and for wildlife habitat. It is also a good source of cinder gravel for use as road base, in manufacturing building blocks, and in covering icy roads.

The potential plant community on this unit is mainly black grama, blue grama, sideoats grama, and galleta. The production of forage is limited by slope and low available water capacity. Slope limits access by livestock and results in overgrazing of the less sloping areas. Cattle usually avoid areas of this unit unless their movement is restricted by fences.

The unit is limited for livestock watering ponds and other water impoundments because of seepage potential

and slope. The Wupatki soil is also limited by the cemented pan.

Rock outcrop provides nesting areas for birds of prey. Elk and deer use this unit as winter range. The grass cover on the unit provides protection for newborn pronghorn fawns.

If this unit is used for homesite development, the main limitation is slope. Access roads should be designed to provide adequate cut-slope grade, and drains are needed to control surface runoff and keep soil losses to a minimum. The hardpan in the Wupatki soil is rippable and therefore is not a serious limitation for most engineering uses.

The use of the unit for septic tank absorption fields is limited by the seepage potential and slope. The Wupatki soil is also limited by the cemented pan, which can be ripped to increase permeability. Slope is a concern in installing septic tank absorption fields. Absorption lines should be installed on the contour. Effluent from septic tank absorption fields can surface in downslope areas and thus create a hazard to health. Because effluent is poorly filtered by the cinders, it can also contaminate the ground water.

This map unit is in capability subclass VIIe.

69—Wupatki-Wukoki very cindery loams, 0 to 15 percent slopes. This map unit is on fan terraces at the foot slopes of cinder cones. Elevation is 5,000 to 6,100 feet. The average annual precipitation is 8 to 14 inches, the average annual air temperature is 52 to 55 degrees F, and the average frost-free period is 150 to 175 days.

This unit is 60 percent Wupatki very cindery loam and 25 percent Wukoki very cindery loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Lomaki very cindery loam, Nalaki very cindery loam, and Rock outcrop. Included areas make up about 15 percent of the total acreage. The percentage varies from one area to another.

The Wupatki soil is very shallow and shallow and is well drained. It formed in pyroclastics. Typically, the surface layer is grayish brown very cindery loam 6 inches thick. The subsoil is grayish brown very cindery loam 10 inches thick. The next layer is a white, silica-cemented hardpan 4 inches thick. The underlying material to a depth of 60 inches or more is very dark gray cinders.

Permeability of the Wupatki soil is moderate. Available water capacity is very low. Water supplying capacity is 8 to 14 inches. Effective rooting depth is 8 to 20 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is slight. Ripping and shattering the hardpan increase the effective rooting depth and improve internal drainage.

The Wukoki soil is deep and well drained. It formed in pyroclastics. Typically, the surface layer is brown very cindery loam 10 inches thick. The subsoil is pale brown and light yellowish brown very cindery loam 8 inches thick. The substratum to a depth of 60 inches or more is dark gray cinders.

Permeability of the Wukoki soil is moderate to a depth of 18 inches and rapid below this depth. Available water capacity is low. Water supplying capacity is 8 to 14 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is slight.

This unit is used mainly as rangeland and for wildlife habitat. It is also used as a source of cinder gravel.

The potential plant community on this unit is mainly black grama, blue grama, and sideoats grama. If the range is poorly managed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community.

This unit is suitable for year-round grazing, and it generally provides high yields of forage. Suitable range management practices are fencing, implementing planned grazing systems, and developing water for livestock. Livestock grazing should be managed to protect the unit from excessive erosion.

The unit is limited for livestock watering ponds and other water impoundments because of seepage potential and slope. The Wupatki soil is also limited by the cemented pan.

Rock outcrop provides nesting areas for birds of prey. Elk and deer use this unit as winter range. The grass cover on the unit provides protection for newborn pronghorn fawns.

If the Wupatki soil is used for homesite development, the main limitations are the cemented pan and slope. The pan is rippable and therefore is not a serious limitation for most engineering uses. If the Wukoki soil is used for homesite development, the main limitation is slope.

The use of the unit for septic tank absorption fields is limited by the seepage potential and slope. The Wupatki soil is also limited by the cemented pan, which can be ripped to increase permeability. Effluent from septic tank absorption fields can surface in downslope areas and thus create a hazard to health. Because effluent is poorly filtered by the cinders, it can also contaminate the ground water.

This map unit is in capability subclass VIs.

70—Ziegler gravelly loam, 0 to 8 percent slopes. This deep, well drained soil is on fan terraces. It formed in alluvium derived dominantly from pyroclastics and basalt. Elevation is 6,500 to 7,100 feet. The average annual precipitation is 14 to 18 inches, the average annual air temperature is 47 to 52 degrees F, and the average frost-free period is 120 to 160 days.

Typically, the surface layer is reddish brown gravelly loam 3 inches thick. The subsoil is reddish brown clay 12 inches thick. The upper 9 inches of the substratum is brown very cindery clay loam. The lower part to a depth of 60 inches or more is cinders.

Included in this unit are small areas of Aut gravelly loam; Cross, Thunderbird, and Valle soils; and Wilaha cindery loam. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

Permeability of the Ziegler soil is slow to a depth of 24 inches and rapid below this depth. Available water capacity is medium. Water supplying capacity is 14 to 18 inches. Effective rooting depth is 40 to 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is slight.

This unit is used as grazable woodland and for firewood harvesting and wildlife habitat. It is also used as a source of cinder gravel.

This unit is well suited to the production of pinyon, oneseed juniper, and Utah juniper. The average site index is 48. The unit can produce 6 cords per acre in a stand of trees that average 5 inches in diameter at a height of 1 foot.

Management that minimizes the hazard of erosion is suggested in harvesting firewood. Disturbed areas can be protected from erosion by seeding adapted plants.

The preferred forage plants on this unit are blue grama, sideoats grama, bottlebrush squirreltail, and buckwheat. The unit has low potential for production of understory forage. If the understory vegetation is poorly managed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community.

Proper grazing use is essential to maintain the vigor and production of forage plants. Where a seed source is lacking in mismanaged areas or where competition from undesirable shrubby plants exists, desirable plants are slow to recover on this unit.

The unit is limited for livestock watering ponds and other water impoundments because of seepage potential.

Maintenance of snags with more than 40 percent bark is essential for birds that nest in cavities. Pinyon nut production is important for wildlife.

This unit is well suited to homesite development.

The use of the unit for septic tank absorption fields is limited by slow permeability. Absorption lines should be placed below the slowly permeable layer. Because effluent is poorly filtered by the cinders, it can contaminate the ground water and thus create a hazard to health.

This map unit is in capability subclass VIs.

71—Ziegler-Cross association, moderately sloping. This map unit is on fan terraces and plateaus. Slope is 0 to 15 percent. Elevation is 6,100 to 6,900 feet. The average annual precipitation is 14 to 18 inches, the average annual air temperature is 49 to 52 degrees F, and the average frost-free period is 120 to 160 days.

This unit is 60 percent Ziegler gravelly loam and 30 percent Cross stony clay loam. The Ziegler soil is on fan terraces; slope ranges from 0 to 8 percent but is mainly 1 to 5 percent. The Cross soil is on plateaus; slope ranges from 8 to 15 percent.

Included in this unit are small areas of Valle soils, Wilaha cindery loam, Springerville very stony clay, and Rock outcrop. Included areas make up about 10 percent of the total acreage. The percentage varies from one area to another.

The Ziegler soil is deep and well drained. It formed in pyroclastics and alluvium derived dominantly from basalt. Typically, the surface layer is reddish brown gravelly loam 3 inches thick. The subsoil is reddish brown clay 12 inches thick. The upper 9 inches of the substratum is brown very cindery clay loam. The lower part to a depth of 60 inches or more is dark gray cinders.

Permeability of the Ziegler soil is slow to a depth of 24 inches and rapid below this depth. Available water capacity is medium. Water supplying capacity is 13 to 16 inches. Effective rooting depth is 40 to 60 inches or more. Runoff is slow to medium, and the hazard of water erosion is slight to moderate. The hazard of soil blowing is slight.

The Cross soil is very shallow and shallow and is well drained. It formed in alluvium and colluvium derived dominantly from basalt and pyroclastics. Typically, the surface layer is dark grayish brown stony clay loam 3 inches thick. The upper 7 inches of the subsoil is dark brown clay. The lower 4 inches is pinkish gray clay. The substratum is white cobbly clay loam 5 inches thick. Basalt is at a depth of 19 inches. Depth to basalt ranges from 8 to 20 inches.

Permeability of the Cross soil is slow. Available water capacity is very low. Water supplying capacity is 13 to 16 inches. Effective rooting depth is 8 to 20 inches. Runoff is slow to medium, and the hazard of water erosion is slight to moderate. The hazard of soil blowing is slight.

This unit is used mainly for livestock grazing and wildlife habitat. The Ziegler soil is also suitable for use as woodland and as a source of cinder gravel.

The Ziegler soil is well suited to the production of pinyon, oneseed juniper, and Utah juniper. The average site index is 48. The soil can produce 6 cords per acre in a stand of trees that average 5 inches in diameter at a height of 1 foot. The preferred forage plants on this soil are blue grama, sideoats grama, bottlebrush squirreltail, and buckwheat. The Ziegler soil has relatively low potential for production of understory forage.

Management that minimizes the hazard of erosion is suggested in harvesting firewood. Disturbed areas can be protected from erosion by seeding adapted plants.

If the understory vegetation is poorly managed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Proper grazing use is essential to maintain the vigor and production of forage plants. Where a seed source is lacking in mismanaged areas or where

competition from undesirable shrubby plants exists, desirable plants are slow to recover on this unit.

The Ziegler soil is limited for livestock watering ponds and other water impoundments because of the seepage potential and slope.

The potential plant community on the Cross soil is mainly black grama, blue grama, sideoats grama, and galleta. The production of forage is limited by depth to bedrock and very low available water capacity. Suitable range management practices are fencing, implementing planned grazing systems, and developing water for livestock. Mechanical treatment is not practical, because the surface is stony and the slopes are steep. Where a seed source is lacking in mismanaged areas or where competition from undesirable shrubby plants exists, desirable plants are slow to recover on this soil.

The Cross soil is limited for livestock watering ponds and other water impoundments because of depth to bedrock and slope.

Elk and deer use this unit as winter range. Maintenance of snags with more than 40 percent bark is essential for birds that nest in cavities. Pinyon nut production is important to wildlife.

The Ziegler soil is well suited to homesite development. The use of the soil for septic tank absorption fields is limited by slow permeability. Absorption lines should be placed below the slowly permeable layer. Because effluent is poorly filtered by the cinders, it can contaminate the ground water and thus create a hazard to health.

If the Cross soil is used for homesite development, the main limitations are depth to bedrock, slope, and shrink-swell potential. Excavation for buildings and roads is limited by very shallow and shallow depth to bedrock. Because removal of the bedrock to an adequate depth could be costly, consider the use of construction methods that do not require excavation. If the soil is used for septic tank absorption fields, the main limitation is the very shallow and shallow depth to bedrock. Consider the use of holding tanks or evaporative beds.

This unit is in capability subclass VIs.

72—Ziegler-Wilaha association, strongly sloping. This map unit is on hillsides. Slope is 3 to 30 percent. Elevation is 5,600 to 7,200 feet. The average annual precipitation is 14 to 18 inches, the average annual air temperature is 49 to 52 degrees F, and the average frost-free period is 120 to 160 days.

This unit is 70 percent Ziegler gravelly loam and 25 percent Wilaha cindery loam. The Ziegler soil has slopes of 3 to 15 percent, and the Wilaha soil has slopes of 15 to 30 percent.

Included in this unit are small areas of steep Wukoki very cindery loam on hillsides. Also included are a few basalt plugs in cinder cone vents. Included areas make up about 5 percent of the total acreage. The percentage varies from one area to another.

The Ziegler soil is deep and well drained. It formed in pyroclastics and alluvium derived dominantly from basalt. Typically, the surface layer is reddish brown gravelly loam 3 inches thick. The upper part of the subsoil is reddish brown clay 12 inches thick. The lower part is brown very cindery clay loam 9 inches thick. The substratum to a depth of 60 inches or more is cinders.

Permeability of the Ziegler soil is slow to a depth of 22 inches and rapid below this depth. Available water capacity is medium. Water supplying capacity is 13 to 16 inches. Effective rooting depth is 40 to 60 inches or more. Runoff is slow to medium, and the hazard of water erosion is slight to moderate. The hazard of soil blowing is slight.

The Wilaha soil is deep and well drained. It formed in pyroclastics and alluvium derived dominantly from basalt. Typically, the surface layer is reddish brown cindery loam 5 inches thick. The upper 9 inches of the subsoil is reddish brown cindery clay loam. The lower 3 inches is pinkish gray, calcareous very cindery loam. The substratum to a depth of 60 inches or more is cinders.

Permeability of the Wilaha soil is moderately slow to a depth of 14 inches and rapid below this depth. Available water capacity is low. Water supplying capacity is 11 to 14 inches. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is slight.

This unit is used as grazable woodland, for firewood harvesting, for wildlife habitat, and as a source of cinder gravel.

The Ziegler soil is well suited to the production of pinyon, Utah juniper, and oneseed juniper. The average site index is 48. The soil can produce 6 cords per acre in a stand of trees that average 5 inches in diameter at a height of 1 foot. The preferred forage plants on this soil are blue grama, sideoats grama, bottlebrush squirreltail, and buckwheat. The soil has moderate potential for production of understory forage.

The Wilaha soil is well suited to the production of pinyon, Utah juniper, and oneseed juniper. The average site index is 33. The soil can produce 3.5 cords per acre in a stand of trees that average 5 inches in diameter at a height of 1 foot. The preferred forage plants on this soil are blue grama, muttongrass, Mexican cliffrose, and skunkbrush. The soil has moderate potential for production of understory forage.

Conventional methods of harvesting timber can be used on this unit. Management that minimizes the hazard of erosion on the Wilaha soil is suggested. Disturbed areas can be protected from erosion by seeding adapted plants.

If the understory vegetation is poorly managed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Proper grazing use is essential to maintain the vigor and production of forage plants. Where a seed source is lacking in mismanaged areas or where competition from undesirable shrubby plants exists, desirable plants are slow to recover on this unit.

The unit is limited for livestock watering ponds and other water impoundments because of slope and the seepage potential.

Maintenance of snags with more than 40 percent bark is essential for birds that nest in cavities. Pinyon nut production is important for wildlife.

If the Ziegler soil is used for homesite development, the main limitations are shrink-swell potential and slope. The effects of shrinking and swelling can be minimized by using proper engineering designs and by backfilling with material that has low shrink-swell potential. Access roads should be designed to control surface runoff and help stabilize cut slopes.

If this soil is used for septic tank absorption fields, the main limitations are slow permeability and slope. Absorption lines should be placed below the slowly permeable layer. Slope is a concern in installing septic tank absorption fields. Absorption lines should be installed on the contour. Effluent from absorption fields can surface in downslope areas and thus create a hazard to health.

If the Wilaha soil is used for homesite development, the main limitations are slope and restricted load supporting capacity. The soil is susceptible to settling if structures are built on it. Settlement can be minimized by compacting the soil. Access roads should be designed to control surface runoff and help stabilize cut slopes.

If this soil is used for septic tank absorption fields, the main limitations are the seepage potential and slope. Slope is a concern in installing septic tank absorption fields. Absorption lines should be installed on the contour. Effluent from absorption fields can surface in downslope areas and thus create a hazard to health.

This unit is in capability subclass VIe.

use and management of the soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils as rangeland and woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

land capability classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations if they are used for field crops, the risk of damage if they are used, and the way they respond to management. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor does it consider possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for woodland, and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey. These levels are defined in the following paragraphs.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have slight limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c* because the soils in

class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

rangeland

Barry K. Wallace, range conservationist, Soil Conservation Service, and Edward A. LeViness, livestock specialist, Cooperative Extension Service, University of Arizona, assisted in writing this section.

About 95 percent of the land in the survey area is rangeland or grazable woodland. More than half of the agricultural income is derived from livestock operations. Cow-calf ranching operations are dominant, but there are some combined cow-calf and steer operations. Some steer operations are in the far western part of the survey area. Sheep operations are in the central part of the survey area.

Privately owned land in the survey area is in the Colorado and Mogollon Plateau regions of northern Arizona. This land is characterized by mixed topography, a wide range in elevation, and a great variety of vegetation. Ranching units range in size from 4,000 acres to 1,000,000 acres. The average ranching unit is about 50,000 acres. The kind of land ownership, the size of the flock or herd, economic conditions, and the background of the operator are a few of the factors that influence the range management practices used on ranches in the area.

Sheep operations in the survey area are dependent on the native desert pasture and hayland in the Salt and Gila River Valleys, in the central and south-central parts of Arizona. This is because the breeding flocks that graze the summer range in the survey area are wintered in these lower valleys. Ewes lamb on these winter pastures during November, December, and January. Sheep usually are sheared during January and February. Generally, the animals are moved from hayland to native desert pasture in March in order to use the native vegetation following precipitation in winter.

In April, lambs are weaned and moved to feedlots in southern Arizona. Replacement ewe lambs are also selected during this time. In May, the breeding ewes, replacement ewe lambs, and rams are moved from winter pasture to summer pasture. Many animals are transported to stock driveways or trails in Yavapai County. These driveways lead some 90 to 100 miles north to high elevation summer range in Coconino County. The drive to summer range usually requires 20 to 25 days. Rams are placed with the breeding flocks at the beginning of the drive north and remain with the ewes on summer range until early in August. A ratio of about 1 ram to 50 ewes normally is maintained.

The flocks arrive at the summer range early in June. This marks the first time during the year that the sheep graze on the state and private lands in Coconino County. After their arrival on summer range, the ewes and rams are divided into flocks of 800 to 1,100 animals each. Each flock is usually assigned a herder and one helper. Although conditions and management objectives vary, about every 4 days flocks are moved to a new grazing site within a pasture. The availability of forage and stock water play an important role in determining these moves.

In summer the flocks are moved within and between different pastures according to an overall pasture management program. Ponds, wells, and pipelines provide the bulk of the stock water on the range. At times it is necessary to haul water by truck to flocks in order to maintain the proper pattern of grazing.

In September and October the herd is rounded up and moved to central working corrals. At this time the animals are vaccinated, sprayed for external parasites, sorted, and transported by truck to valleys at lower elevations for the winter.

Cattle ranches in the survey area are primarily yearlong grazing operations. Many of the operating units have permits for summer grazing in either the adjacent Coconino National Forest or the Kaibab National Forest. The interdependence of private and public grazing lands is very important to most cattle operations.

In a typical cow-calf operation in the area, fall roundup usually begins in September. On many ranches the roundup includes not only the gathering and working of cattle, but the movement of the herd to summer range on land administered by the Forest Service. The fall roundup on private and state land usually starts 30 to 40 days later and may last until November.

The roundup includes steers that were held over from the previous year's calf crop. These animals are shipped directly to feedlots. Calves born in spring are weaned and either shipped to feedlots or held over until the following spring.

During the roundup, replacement heifers are selected and some cows and bulls are culled from the herd. The animals culled are usually those whose productivity is impaired because of injuries, age, or reproductive capacity.

After roundup is completed, animals that were summered on national forest land are moved onto privately owned land or onto land leased from the state. These cattle spend late fall, winter, and spring on these lands.

A supplemental feeding program for the herd normally begins sometime in January and continues into April. The supplemental feed consists of concentrated and high protein feed that is used to complement the native forage, which is dormant during periods of cold weather. This feed is provided to the cows to prepare them for calving and to compensate for nutritional deficiencies in the native forage. Calving normally begins in February and may be completed by May. Bulls are placed back with the cows 50 to 60 days after the beginning of calving. Breeding is done primarily from April to July. An average ratio of one bull to 25 cows is maintained during the breeding period.

In April and May a spring roundup is held. During this roundup the yearling steers are gathered for shipping to

feedlots. Calf branding, dehorning, and vaccinating are done at this time. Replacement heifers and bulls are gathered for placement with the breeding herd. This spring roundup also prepares all the animals for transfer onto national forest land for the summer.

In the movement from winter to summer range, the cows and calves are divided into "drives". A drive consists of approximately 300 cows and calves. The cattle generally are driven by horseback riders, and the movement takes about 1 to 4 days, depending on the distance from winter range to summer range. Some operators transport cattle to the summer range by truck. The cattle graze on the summer range until the fall roundup.

Some cattle operations do not use land administered by the Forest Service in their grazing management programs. In these operations the breeding herd is maintained the entire year on privately owned land and on land leased from the state. The vast majority of the operating units, however, have permits for grazing on national forest land.

The land administered by the Forest Service is primarily for summer use because of its high altitude and snow cover in most winters. Most of the private and state administered land is at lower elevations and can be used year-round. This form of use has caused some deterioration of the plant community. Private and state adiministered lands in the survey area have suffered a general reduction in the cool-season perennial grass component of the native plant community. Cool-season grasses are those grasses that begin their growth early in spring using moisture accumulated in the soil as a result of precipitation in winter. These grasses are adversely affected by a constant grazing pressure in spring and fall. The number of palatable shrubs has also been reduced on these lands by grazing pressure in winter and spring.

Those forest lands that receive only summer use generally have an abundance of cool-season grasses. This is because the livestock mainly use the warm-season grasses in summer. The warm-season grasses primarily use moisture received during thunderstorms in summer to achieve their annual growth.

Effective management of rangeland is dependent upon many factors. The season of use, intensity of use, the kind of grazing animals, distribution of grazing animals, and a knowledge of the resource capability are very important management considerations.

In areas that have similar climate and topography, differences in the kind and amount of vegetation produced on rangeland are closely related to the kind of soil. Effective management is based on the relationship between the soils, vegetation, and water.

Table 5 shows, for each soil, the range site; the total annual production of vegetation in favorable, normal, and unfavorable years; the characteristic vegetation; and the average percentage of each species. Only those soils that are used as or are suited to rangeland are listed. Explanation of the column headings in table 5 follows.

A *range site* is a distinctive kind of rangeland that produces a characteristic natural plant community that differs from natural plant communities on other range sites in kind, amount, and proportion of native range plants. The relationship between soils and vegetation was established during this survey; thus, range sites generally can be determined directly from the soil map. Soil properties that affect moisture supply and plant nutrients have the greatest influence on the productivity of range plants. Soil reaction, salt or lime content, and topographic position are also important.

Total production is the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural plant community. It includes all vegetation, whether or not it is palatable to grazing animals. It includes the current year's growth of leaves, twigs, flowers, and fruits of woody plants. It does not include the increase in stem diameter of trees and shrubs. It is expressed in pounds per acre of air-dry vegetation for favorable, normal, and unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In a normal year, growing conditions are about average. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Dry weight is the total annual yield per acre reduced to a common percent of air dry moisture.

Characteristic vegetation—the grasses, forbs, and shrubs that make up most of the potential natural plant community on each soil—is listed by common name. Under *composition*, the expected percentage of the total annual production is given for each species making up the characteristic vegetation. The amount that can be used as forage depends on the kinds of grazing animals, the grazing season, and availability of forage. Many plants, trees, and shrubs are inaccessible or not within reach of foraging animals.

Range management requires a knowledge of the kinds of soil and of the potential natural plant community. It also requires an evaluation of the present range condition. Range condition is determined by comparing the present plant community with the potential natural plant community on a particular range site. The more closely the existing community resembles the potential community, the better the range condition. Range condition is an ecological rating only. It does not have a specific meaning that pertains to the present plant community in a given use.

The primary objective in range management is to control grazing so that the plants growing on a site are about the same in kind and amount as the potential natural plant community for that site. Such management generally results in the optimum production of vegetation, conservation of water, and control of erosion. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

The forage plants in many parts of the survey area have been depleted by excessive and untimely use. There has been a general reduction in cool-season grasses and a general increase in woody, nonforage plants. Productivity of forage plants generally is below the potential of the soils. Uneven livestock distribution has created localized overuse and underuse of forage. Gully erosion is extensive on some of the bottom land soils, and sheet erosion occurs on some of the upland soils.

Many areas that were once open grassland have been encroached upon by juniper trees. Adequate fuel, which the grass provided, is not now available to carry the natural fires that once controlled the encroachment of juniper. Broom snakeweed, a low-growing half-shrub, has also dramatically increased, particularly on the shallow soils. These woody plants compete for soil moisture with forage plants that should be dominant on the sites.

Abnormal amounts of woody plants, excessive erosion, and the abundance of toxic plants are all symptomatic of a deteriorated range condition; however, a systematic range improvement program can remedy this situation.

Livestock distribution can be improved by fencing and developing additional watering facilities. Priority should be given to permanent livestock watering facilities. Livestock watering ponds are not dependable and can cause grazing distribution problems. Livestock wells, pipelines, storage tanks, and spring developments are much more dependable means of providing water. Fences should be used to divide large pastures into smaller, more manageable units. Fences and watering facilities can be used to force animals to use areas that might otherwise be unused.

Moisture-robbing shrubs and trees can be managed in a number of ways. Several mechanical forms of brush management have been used in the survey area, with varying degrees of success. Large areas of juniper have been mechanically treated. Chaining or cabling of the trees has met with mixed success. The individual "pushing" of trees by heavy equipment has been more successful. The use of approved herbicides, particularly on shrubby plants, is effective if soil moisture and other growing conditions are satisfactory.

Gully erosion has a profound effect on forage production on bottom land soils. These soils are potentially the most productive ones in the survey area. When the plant cover on these soils deteriorates, the soils are more susceptible to erosion. Deteriorated bottom land sites receive extra runoff from adjacent sites and readily respond to management. The best treatment of these sites is to allow the site to be rested from livestock grazing. Among the other suitable treatment practices are grade stabilization and use of water spreading structures. The improvement of many bottom land sites can be accelerated by seeding locally adapted forage plants.

Gully erosion can be controlled by adequate treatment and management of the upland soils that contribute runoff to the bottom lands. Large gullied areas may need mechanical treatment. Minimizing the effects of sheet erosion on upland soils is accomplished by maintaining or improving the plant cover. Increasing the plant cover increases moisture infiltration, improves growing conditions, and reduces runoff and sheet erosion. Severely depleted upland sites may require range seeding of adapted species to improve productivity and to increase the ground cover.

Management of the rangeland resources in this area should be directed toward meeting the native plant requirements. Critical growth stages in the native plant community must be recognized and considered when selecting a grazing management program. A systematic grazing program includes proper stocking levels and protection from continuous use.

A good range manager will incorporate resource protection or improvement with good livestock management practices. Recognition of the resource potentials and the hazards of resource misuse are the keys to properly selecting management programs. Sound range management based upon soil survey information and other rangeland inventory information is the basis for maintaining or improving the production and quality of forage.

woodland management and productivity

Richard J. King and Barry K. Wallace, range conservationists, Soil Conservation Service, assisted in writing this section.

About 525,000 acres of pinyon and juniper woodland is in the survey area. Most of woodland is in the southwestern, northwestern, and southeastern parts of the area.

The woodland is at elevations between those of the ponderosa pine forests (outside the survey area) and the cold desert grassland. Pinyon and juniper woodland generally is sparse and is low in productivity at the lower elevations, where it is dominated by juniper. At the higher elevations, the woodland is more productive. Pinyon becomes dominant as the woodland grades into the ponderosa pine zone because of the increasing precipitation and decreasing temperatures at the higher elevations.

Historically, stands of pinyon and juniper were restricted to certain sites by natural range fires and the characteristics of the soils (*16*). Young trees are very susceptible to grass fires until their crowns grow well above the grasses; consequently, fires normally eliminate or greatly thin tree seedlings on soils that produce good stands of grass. About 15 to 40 years is necessary for trees to grow tall enough to resist grass fires.

Production of grass cover is limited on soils that are shallow or stony. This restricts the frequency and distribution of range fires and allows stands of pinyon and juniper to develop. The root systems of pinyon and juniper are well adapted to these sites. In general, the

density of the stands of pinyon and juniper is greater on soils that are shallow or stony.

Settlement of the area and extensive overgrazing between 1860 and 1920 dramatically changed the ecology of the woodland. The excessive grazing reduced the grass fuel available for natural range fires. Grasses were not able to compete with tree seedlings for moisture. As a result, the woodland stands became thicker and trees invaded many grassland areas.

Since the 1920's the number of livestock grazed and the management practices used have reduced overgrazing; thus, the range condition generally has stabilized or improved. Because of reduced ground cover or fire suppression policies, or both, however, range fires are very rare. Woodland species thus continue to increase and spread.

Oneseed juniper is typically the dominant juniper in the part of the survey area north and east of Flagstaff. Here, about half of the precipitation falls in summer. Utah juniper becomes dominant as the amount of winter precipitation increases in the western and far northern parts of the survey area. Pinyon is the most common pine in the survey area. Singleleaf pinyon grows in places.

In the past, large acreages of woodland were cabled, chained, bulldozed, or burned in order to increase the production of forage. Woodland was also a major source of railroad ties, fenceposts, and firewood (*5*). Today the pinyon and juniper woodland is recognized as important for wildlife habitat and recreation and as a valuable source of pinyon nuts and Christmas trees. As energy demands and costs increase, firewood harvesting increases in importance. The value of woodland for livestock grazing is also increasing. Pinyon and juniper wood is not suitable for lumber.

Managing pinyon and juniper woodland for sustained yields is a relatively new and undeveloped technique. Conversion to rangeland has been the trend in the past, and several satisfactory conversion and control methods are available. Because of the recent demand for firewood and projected future demand, however, the woodland should be managed with consideration for its value as firewood (*7*).

More information on the potential of the woodland for firewood production is given in table 6. How long it takes to attain these production levels has not been fully determined. It is not precisely known, for example, how many years it takes a given site to produce a cord of wood, because accurate methods of determining the age of juniper have not been developed. These trees have been observed to add from 0 to 5 growth rings during a growing season. It is also difficult to determine the age of pinyon. While the standing volume and value of a stand for firewood can be determined, the practicability of managing cutover or potential woodland sites for future harvest is not well understood.

Before the economics of livestock versus firewood production can be evaluated, optimum tree stocking rates, cutting cycles, and harvest volumes for the various site classes need to be determined (*15*). Managing woodland for a combination of both uses may be the most desirable option.

Despite the lack of specific knowledge, general woodland management guidelines are apparent. Trees should be allowed to regrow on sites known to be productive or on soils that formerly supported dense stands of trees. Invasion of trees on former grassland should be discouraged to prevent degradation of the grass cover.

Trees can be thinned so that root systems are not overlapping significantly. This allows development of a grass understory as well as more vigorous growth of trees. The understory growth increases as tree spacing increases. In general, the lateral root systems of juniper extend outward about one to two times the tree's height.

Where conversion of woodland to rangeland is desired, choose the poorer tree sites where the soils are better suited to grass production. Leave cover areas for wildlife and livestock, particularly on steep slopes, in drainageways, and along travel routes.

When developing a woodland or a rangeland and woodland management plan, it is important to know the soils and the site potential. Consideration should be given to all woodland values, site opportunities and limitations, and economic factors.

Table 6 can be used by woodland owners or forest managers in planning the use of soils for wood crops. Only those soils suitable for wood crops are listed. The table lists the ordination (woodland suitability) symbol for each soil. Soils assigned the same ordination symbol require the same general management and have about the same potential productivity.

The first part of the *ordination symbol*, a number, indicates the potential productivity of the soils for important trees. The number 1 indicates very high productivity; 2, high; 3, moderately high; 4, moderate; and 5, low. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *x* indicates stoniness or rockiness; *w*, excessive water in or on the soil; *t*, toxic substances in the soil; *d*, restricted root depth; *c*, clay in the upper part of the soil; *s*, sandy texture; *f*, high content of coarse fragments in the soil profile; and *r*, steep slopes. The letter *o* indicates that limitations or restrictions are insignificant. If a soil has more than one limitation, the priority is as follows: x, w, t, d, c, s, f, and r.

In table 6, *slight, moderate,* and *severe* indicate the degree of the major soil limitations to be considered in management.

Ratings of the *erosion hazard* indicate the risk of loss of soil in well managed woodland. The risk is *slight* if the expected soil loss is small, *moderate* if measures are needed to control erosion during logging and road construction, and *severe* if intensive management or special equipment and methods are needed to prevent excessive loss of soil.

Ratings of *equipment limitation* reflect the characteristics and conditions of the soil that restrict use of the equipment generally needed in woodland management or harvesting. A rating of *slight* indicates that use of equipment is not limited to a particular kind of equipment or time of year; *moderate* indicates a short seasonal limitation or a need for some modification in management or in equipment; and *severe* indicates a seasonal limitation, a need for special equipment or management, or a hazard in the use of equipment.

Seedling mortality ratings indicate the degree to which the soil affects natural regeneration of tree seedlings when plant competiton is not a limiting factor. Properties of the soil, such as frost heaving, that affect seedling mortality are rated as follows. A rating of *slight* indicates that the expected mortality is less than 25 percent; *moderate*, 25 to 50 percent; and *severe*, more than 50 percent.

Ratings of *plant competition* indicate the degree to which understory plants are expected to invade or grow where there are openings in the tree canopy. Understory plants may inhibit growth of established trees or tree seedlings by competing for moisture and sunlight. A rating of *slight* indicates little or no competition from other plants; *moderate* indicates that plant competition is expected to hinder the development of a fully stocked stand of desirable trees; *severe* indicates that plant competition is expected to prevent the establishment of a desirable stand unless the site is intensively prepared, weeded, or otherwise managed to control undesirable plants.

The *potential productivity* of merchantable or *common trees* on a soil is expressed as a *site index*. This index is the average height, in feet, that dominant and codominant trees of a given species attain in a specified number of years. The site index applies to fully stocked, even-aged, unmanaged stands. Commonly grown trees are those that woodland managers generally favor in intermediate or improvement cuttings. They are selected on the basis of growth rate, quality, value, and marketability.

woodland understory vegetation

Richard J. King and Barry K. Wallace, range conservationists, Soil Conservation Service, assisted in writing this section.

Understory vegetation consists of grasses, forbs, shrubs, and other plants. Some types of forest, under proper management, can produce enough understory vegetation to support grazing of livestock or wildlife, or both. This type of forest is called grazable woodland.

The quantity and quality of understory vegetation vary with the kind of soil, the age and kind of trees in the canopy, the density of the canopy, and the depth and condition of the litter. The density of the woodland canopy affects the amount of light that understory plants receive during the growing season. It also determines the amount of litter on the ground, which may inhibit growth of herbaceous plants.

Table 7 shows, for each soil suitable for woodland use, the potential for producing understory vegetation. The total production of understory vegetation includes the herbaceous plants and the leaves, twigs, and fruit of woody plants up to a height of 4 1/2 feet. It is expressed in pounds per acre of air-dry vegetation in favorable, normal, and unfavorable years. In a favorable year, soil moisture is above average during the optimum part of the growing season; in a normal year, soil moisture is average; and in an unfavorable year, it is below average.

Table 7 also lists the common names of the characteristic vegetation on each soil and the percentage composition, by air-dry weight, of each kind of plant. The kind and percentage of understory plants expected are those in a fully stocked stand of trees.

recreation

David W. Seery, area biologist, Soil Conservation Service, assisted in writing this section.

The soils of the survey area are rated in table 8 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 8, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 8 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 11 and interpretations for dwellings without basements and for local roads and streets in table 10.

Camp areas require site preparation such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary

facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have gentle slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Steep slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of pebbles, stones, and boulders; is firm after rains; and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking, horseback riding, and bicycling should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting and filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

wildlife habitat

David W. Seery, area biologist, Soil Conservation Service, assisted in writing this section.

Many kinds of wildlife commonly are in the survey area. They include elk, mule deer, pronghorn, gray fox, pinon jay, stellar jay, red-tailed hawk, great horned owl, burrowing owl, horned lark, sparrows, mourning dove, marsh hawk, coyote, and bobcat.

Wildlife species such as pronghorn, horned lark, marsh hawk, red-tailed hawk, and burrowing owl are common in areas of grassland. Species such as gray fox, pinon jay, and stellar jay generally prefer areas of woodland. The gray fox climbs trees to escape predators. Pinon jay and stellar jay eat seeds and nuts. Mule deer prefer shrubby, rocky areas that have plant cover, including grazable shrubs.

Several species of wildlife use a wide range of habitats because of weather limitations, special requirements for rearing young, and availability of food. Elk use grassland, pinyon and juniper woodland, meadows, pine forests, spruce-fir forests, and tundra. Mourning dove eat a variety of seeds and travel great distances each day to make good use of seed crops. They usually nest in trees. Coyotes live where the supply of food is adequate. They have very few enemies, and the survival rate of the young is high.

Several kinds of habitat are in the survey area. Grassland makes up a large part of the area. Areas of grassland support short grasses or midgrasses that are adapted to warm or cool weather. Forbs and shrubs provide valuable food and cover. Most grassland is in areas of low, rolling hills that are dissected by small drainageways. These drainageways support different kinds of plants.

Woodland areas support pinyon, juniper, or ponderosa pine. These areas are at a slightly higher elevation than the grassland. Pinyon and juniper woodland also supports grasses, forbs, and shrubs that are beneficial for wildlife. Pinyon nuts provide food for many wildlife species. The berries of the juniper, as well as the foliage, are eaten when other food is not available.

Wildlife populations increase after trees are removed because of an increase in the species of plants available and in the insect population. Practices such as tree removal should be planned according to the properties of the individual soils, the kinds of wildlife present, topography, and wildlife travel patterns.

Riparian vegetation in the area such as willow, sumac, cottonwood, and Arizona walnut grows along drainageways and near other areas of water. Alteration of riparian areas affects large numbers of wildlife and many different species.

Among the threatened and endangered wildlife species that have been observed in the survey area are bald eagle, peregrine falcon, and black-footed ferret. Bald eagles are predatory birds that usually are observed hunting or nesting near water. They may be locally abundant during migration. Peregrine falcons usually nest in cliffs near water, where other birds are available for hunting. Black-footed ferrets commonly live near prairie dog towns. No sightings of black-footed ferrets have been recorded in recent years.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 9, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining

specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and barley.

Grasses and legumes are domestic perennial grasse and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, lovegrass, bromegrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are Indian ricegrass, sunflower, wheatgrass, and grama.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, the available water capacity, and wetness. Examples of these plants are oak, Arizona walnut, box elder, and hawthorn. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are Russian-olive, autumn-olive, and crabapple.

Coniferous plants furnish browse, seeds, and cones. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pinyon and juniper.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, and foliage. Soil properties and features that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and soil moisture. Examples of shrubs are mountainmahogany, antelope bitterbrush, Mexican cliffrose, winterfat, and fourwing saltbush.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, bulrushes, and sedges.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include meadowlark, field sparrow, cottontail, and elk.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include wild turkey, thrushes, woodpeckers, squirrels, gray fox, elk, deer, and bear.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, muskrat, mink, and beaver.

Habitat for rangeland wildlife consists of areas of shrubs and wild herbaceous plants. Wildlife attracted to rangeland include antelope, mule deer, meadowlark, and horned lark.

engineering

James Kosar, Jr., area engineering specialist, Soil Conservation Service, assisted in writing this section.

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development,

Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

building site development

Table 10 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. Flooding, shrink-swell potential, and organic layers can cause the movement of footings. Depth to bedrock or to a cemented pan, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and

maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, depth to bedrock or to a cemented pan, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

sanitary facilities

Table 11 shows the degree and the kind of soil limitations that affect septic tank absorption fields and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 11 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field or if slope is excessive. There must be unsaturated soil material beneath the absorption field to effectively filter the effluent. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 11 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 11 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

construction materials

Table 12 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a probable or improbable source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 12, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

water management

Table 13 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not

favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect irrigation and terraces and diversions.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

soil properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

engineering index properties

Table 14 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil series and their morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If a soil contains particles coarser than sand, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (*3*) and the system adopted by the American Association of State Highway and Transportation Officials (*2*).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as Pt. Soils exhibiting engineering properties of two groups can have a dual classification, for example, SP-SM.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an oven-dry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are rounded to the nearest 5 percent.

Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

physical and chemical properties

Table 15 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, and plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earth-moving operations.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Salinity is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of soil if used as construction material, and the potential of the soil to corrode metal and concrete.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value the more susceptible the soil is to sheet and rill erosion by water. The hazard of erosion is slight for values of K that are 0.20 or less, moderate for values of 0.20 to 0.32, and high for values of more than 0.32.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility of soil to wind erosion and the amount of soil lost. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops.

They are extremely erodible, and vegetation is difficult to establish.

2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control wind erosion are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control wind erosion are used.

5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control wind erosion are used.

6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.

7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to wind erosion.

The hazard of erosion is high for soils in wind erodibility groups 1, 2, and 3; moderate for soils in groups 4 and 4L; and slight for soils in groups 5, 6, 7, and 8.

soil and water features

Table 16 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt and water in swamps and marshes is not considered flooding.

Table 16 gives the estimated frequency of flooding. Frequency is expressed as none, rare, common, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *common* that it is likely under normal conditions; *occasional* that it occurs on an average of once or less in 2 years; and *frequent* that it occurs on an average of more than once in 2 years.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is specified as either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavations.

Cemented pans are cemented or indurated subsurface layers within a depth of 5 feet. Such pans cause difficulty in excavation. Pans are classified as thin or thick. A thin pan is less than 3 inches thick if continously indurated or less than 18 inches thick if discontinuous or fractured. Excavations can be made by trenching machines, backhoes, or small rippers. A thick pan is more than 3 inches thick if continously indurated or more than 18

inches thick if discontinuous or fractured. Such a pan is so thick or massive that blasting or special equipment is needed in excavation.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured clayey soils that have a high water table in winter are most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate,* or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

classification of the soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*20*). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. In table 17, the soils of the survey area are classified according to the system. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Entisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Fluvent (*Fluv*, meaning flood plain sediment, plus *ent*, from Entisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Torrifluvents (*Torri*, meaning hot and dry, plus *fluvent*, the suborder of the Entisols that formed in flood plain sediment).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Torrifluvents.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-silty, mixed, (calcareous), mesic Typic Torrifluvents.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

soil series and their morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the Soil Survey Manual (*19*). Many of the technical terms used in the descriptions are defined in Soil Taxonomy (*20*). Unless otherwise stated, colors in the descriptions are for dry soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed soil map units."

Apache series

The Apache series consists of very shallow and shallow, well drained, moderately permeable soils on plateaus and mesas. These soils formed in colluvium and alluvium derived from basalt and pyroclastics. Slope ranges from 2 to 15 percent. The average annual precipitation is 12 to 16 inches, and the average annual air temperature is 50 to 54 degrees F.

These soils are loamy, mixed, mesic Lithic Haplustolls.

Typical pedon of an Apache cobbly clay loam in an area of Cross-Apache complex, 2 to 15 percent slopes, about 5 miles east of Seligman along the county line,

1,200 feet south and 500 feet west of the north quarter corner of sec. 35, T. 23 N., R. 5 W.

A1—0 to 8 inches; brown (10YR 5/3) cobbly clay loam, dark brown (10YR 3/3) moist; weak fine and medium granular structure; slightly hard, very friable, sticky and plastic; many very fine and fine roots; many very fine and fine pores; 15 percent pebbles and 15 percent cobbles; strongly effervescent; moderately alkaline; abrupt smooth boundary.
Cca—8 to 18 inches; very pale brown (10YR 7/3) gravelly loam, very pale brown (10YR 7/3) moist; massive; slightly hard, very friable, slightly sticky and nonplastic; few very fine roots; many very fine and fine tubular pores; 20 percent pebbles and 10 percent cobbles with lime coating; about 35 percent calcium carbonate; violently effervescent; moderately alkaline; abrupt smooth boundary.
IIR—18 inches; fractured basalt with lime coating on upper surface.

Depth to bedrock ranges from 6 to 20 inches. The profile is 5 to 35 percent coarse fragments. The A1 horizon is brown, dark brown, or dark grayish brown. The Cca horizon is pale brown or very pale brown. It is gravelly loam or cobbly loam. Some pedons have a B horizon.

Ashfork series

The Ashfork series consists of moderately deep, well drained, slowly permeable soils on hillsides. These soils formed in alluvium and colluvium derived from basalt and pyroclastics. Slope ranges from 1 to 15 percent. The average annual precipitation is 12 to 14 inches, and the average annual air temperature is 49 to 54 degrees F.

These soils are fine, montmorillonitic, mesic Aridic Argiustolls.

Typical pedon of Ashfork gravelly clay loam, 1 to 15 percent slopes, 100 feet south and 700 feet east of the northwest corner of sec. 33, T. 26 N., R. 5 E.

A1—0 to 2 inches; brown (10YR 5/3) gravelly clay loam, dark brown (7.5YR 3/2) moist; weak fine platy structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine roots; many very fine and fine vesicular pores; 20 percent pebbles; moderately alkaline; clear smooth boundary.
B21t—2 to 7 inches; dark reddish brown (5YR 3/3) clay, dark reddish brown (5YR 3/3) moist; moderate medium and coarse prismatic structure parting to moderate fine subangular blocky; hard, firm, sticky and plastic; common very fine and fine roots; few very fine tubular and interstitial pores; common thin clay films on faces of peds and in pores; 10 percent pebbles; moderately alkaline; clear wavy boundary.
B22tca—7 to 12 inches; pale brown (10YR 6/3) clay, brown (10YR 4/3) moist; weak fine subangular blocky structure; hard, very friable, sticky and plastic; common very fine and fine roots; common very fine tubular and interstitial pores; common thin clay films on faces of peds and in pores; common fine and medium soft lime masses; 10 percent pebbles; strongly effervescent; moderately alkaline; gradual wavy boundary.
B3ca—12 to 17 inches; light yellowish brown (10YR 6/4) clay loam, brown (7.5YR 5/4) moist; weak fine subangular blocky structure; hard, very friable, sticky and plastic; few very fine and fine roots; common very fine tubular pores; 10 percent pebbles; violently effervescent; moderately alkaline; clear wavy boundary.
IICca—17 to 30 inches; white (10YR 8/2) stony loam, very pale brown (10YR 7/3) moist; massive; slightly hard, very friable, slightly sticky and plastic; few very fine and fine roots; common very fine tubular pores; 30 percent stones; 55 percent calcium carbonate; violently effervescent; moderately alkaline; abrupt smooth boundary.
IIIR—30 inches; fractured vesicular basalt; common carbonates in joints.

Thickness of the solum and depth to the calcic horizon range from 10 to 20 inches. Depth to bedrock ranges from 20 to 40 inches. The solum is 10 to 35 percent coarse fragments. The A1 horizon is brown, dark brown, or dark grayish brown. The B2t horizon is pale brown, brown, or dark reddish brown. The Cca horizon is brown, light yellowish brown, very pale brown, or white. It is stony clay loam or stony loam and is 20 to 60 percent calcium carbonate.

Aut series

The Aut series consists of moderately deep, well drained, moderately permeable soils on plateaus and mesas. The soils formed in alluvium derived from basalt and limestone. Slope ranges from 0 to 8 percent. The average annual precipitation is 12 to 14 inches, and the average annual air temperature is 49 to 54 degrees F.

These soils are fine-loamy, carbonatic, mesic Aridic Calciustolls.

Typical pedon of an Aut gravelly loam in an area of Aut-Cross association, moderately sloping, about 18 miles north of Williams; 1,200 feet east of the southwest corner of sec. 33, T. 25 N., R. 2 E.

A11—0 to 2 inches; brown (10YR 5/3) gravelly loam, dark brown (10YR 3/3) moist; weak thin platy structure parting to weak very fine granular; slightly hard, very friable, nonsticky and nonplastic; many fine roots; common very fine and fine vesicular and irregular pores; 15 percent basalt pebbles; strongly effervescent; moderately alkaline; abrupt smooth boundary.
A12—2 to 7 inches; brown (10YR 4/3) gravelly loam, dark brown (10YR 3/3) moist; weak medium

subangular blocky structure; slightly hard, very friable, slightly sticky and nonplastic; many very fine roots; few fine tubular and irregular pores; 15 percent basalt pebbles; strongly effervescent; moderately alkaline; clear wavy boundary.

A13—7 to 12 inches; brown (10YR 4/3) cobbly loam, dark brown (10YR 3/3) moist; weak to moderate subangular blocky structure; slightly hard, very friable, slightly sticky and nonplastic; many very fine roots; few fine tubular and irregular pores; 20 percent cobbles; strongly effervescent; moderately alkaline; gradual wavy boundary.

B2ca—12 to 17 inches; brown (10YR 5/3) gravelly loam, dark brown (10YR 3/3) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; few fine tubular pores; 20 percent pebbles; violently effervescent; moderately alkaline; gradual wavy boundary.

C1ca—17 to 26 inches; light brownish gray (10YR 6/2) cobbly loam, yellowish brown (10YR 5/4) moist; massive; slightly hard, friable, slightly sticky and nonplastic; many very fine roots; 20 percent pebbles and 15 percent cobbles; violently effervescent; moderately alkaline; diffuse broken boundary.

C2ca—26 to 38 inches; very dark gray (N 3/0) cobbly loam, black (N 2.5/0) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; 15 percent lime-coated pebbles and 20 percent lime-coated, cobble-sized basalt fragments; lime coating is strongly cemented and is white (N 8/0) dry and pinkish white (7.5YR 8/2) moist; porous basalt fragments are partially filled with lime; some of the gravel consists of 1/2-inch lime fragments; violently effervescent; moderately alkaline; abrupt wavy boundary.

IIR—38 inches; fractured basalt; common carbonate coatings in joints.

Depth to the calcic horizon ranges from 6 to 16 inches. Depth to bedrock ranges from 20 to 40 inches. The profile is 5 to 30 percent coarse fragments. The A1 and B2ca horizons are grayish brown or brown. The Cca horizon is light brownish gray or very dark gray.

Boquillas series

The Boquillas series consists of moderately deep, well drained, slowly permeable soils on plateaus and mesas. These soils formed in alluvium and colluvium derived from tuff and acid igneous rock. Slope ranges from 1 to 15 percent. The average annual precipitation is 14 to 18 inches, and the average annual air temperature is 50 to 54 degrees F.

These soils are fine, montmorillonitic, mesic Aridic Argiustolls.

Typical pedon of a Boquillas gravelly loam in an area of Boquillas-Seligman complex, 1 to 15 percent slopes, about 2 miles north of Mount Floyd; 300 feet west of the center of sec. 33, T. 24 N., R. 4 W.

A11—0 to 3 inches; brown (7.5YR 5/2) gravelly loam, dark brown (7.5YR 3/2) moist; moderate thin platy structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine and fine roots; common fine vesicular pores; 20 percent pebbles; mildly alkaline; clear smooth boundary.

A12—3 to 6 inches; brown (7.5YR 5/2) clay loam, dark brown (7.5YR 3/2) moist; weak fine and medium subangular blocky structure; slightly hard, friable, sticky and plastic; common very fine and fine roots and few medium roots; few fine interstitial pores; 10 percent pebbles; mildly alkaline; abrupt smooth boundary.

IIB21t—6 to 12 inches; dark reddish gray (5YR 4/2) gravelly clay, dark reddish brown (5YR 3/2) moist; moderate fine and medium subangular blocky structure; hard, firm, sticky and plastic; common fine and coarse roots; few very fine interstitial pores; common thin clay films on faces of peds; 25 percent pebbles; mildly alkaline; clear smooth boundary.

IIB22t—12 to 19 inches; dark reddish brown (5YR 4/3) gravelly clay, dark reddish brown (5YR 3/3) moist; strong medium and coarse prismatic structure parting to moderate very fine and fine subangular blocky; very hard, very firm, very sticky and very plastic; common very fine roots and few fine and coarse roots; few very fine interstitial pores; few thin clay films on faces of peds; common pressure faces; 15 percent pebbles; mildly alkaline; clear smooth boundary.

IIB23t—19 to 23 inches; dark reddish brown (5YR 3/4) gravelly clay, dark reddish brown (5YR 3/4) moist; strong medium and coarse prismatic structure parting to strong medium subangular blocky; very hard, very firm, very sticky and very plastic; few very fine, fine, and coarse roots; few very fine interstitial pores; few thin clay films on faces of peds; common pressure faces; 25 percent pebbles; mildly alkaline; clear wavy boundary.

IIIC1ca—23 to 38 inches; reddish brown (N 4/0) very gravelly clay loam, dark reddish brown (5YR 3/4) moist; massive; very hard, friable, sticky and plastic; few fine and medium roots; many soft lime masses; 40 percent pebbles and 10 percent cobbles that are lime-coated; strongly effervescent; mildly alkaline; abrupt wavy boundary.

IVC2r—38 inches; very hard siliceous tuff; can be dug with spade after soaking with water.

Tuff is at a depth of 20 to 40 inches. The solum is 18 to 34 inches thick. The argillic horizon is 5 to 50 percent coarse fragments but averages less than 35 percent. The A1 horizon is brown or dark grayish brown. The B2 horizon is dark reddish gray or dark reddish brown. It is clay or gravelly clay. The C horizon is reddish brown or dark reddish brown.

Boysag series

The Boysag series consists of shallow, well drained, slowly permeable soils on plateaus and mesas. These soils formed in eolian deposits underlain by alluvium derived from calcareous sandstone and limestone. Slope ranges from 0 to 8 percent. The average annual precipitation is 12 to 14 inches, and the average annual air temperature is 50 to 54 degrees F.

These soils are clayey, mixed, mesic Lithic Ustollic Haplargids.

Typical pedon of a Boysag gravelly loam in an area of Winona-Boysag gravelly loams, 0 to 8 percent slopes, about 36 miles north of Ashfork; 2,500 feet west and 400 feet north of the southeast corner of sec. 22, T. 27 N., R. 2 W.

A1—0 to 3 inches; reddish brown (5YR 5/4) gravelly loam, dark reddish brown (5YR 3/4) moist; weak medium platy structure; soft, very friable, slightly sticky and nonplastic; few fine roots; many very fine interstitial and vesicular pores; 20 percent pebbles; mildly alkaline; abrupt smooth boundary.

B1t—3 to 5 inches; reddish brown (5YR 5/4) gravelly clay loam, dark reddish brown (5YR 3/3) moist; weak fine and medium subangular blocky structure; slightly hard, friable, sticky and plastic; common very fine roots and few coarse roots; many very fine interstitial pores and few fine tubular pores; few thin clay films in pores and on faces of peds; 20 percent pebbles; moderately alkaline; gradual smooth boundary.

B2t—5 to 13 inches; yellowish red (5YR 5/6) clay, dark reddish brown (5YR 3/4) moist; weak medium prismatic structure parting to moderate fine and medium subangular blocky; very hard, firm, sticky and plastic; common very fine roots and few coarse roots; common very fine tubular pores; many thin clay films on faces of peds; 10 percent pebbles; moderately alkaline; abrupt irregular boundary.

Cca—13 to 16 inches; pinkish white (5YR 8/2) very cobbly loam, pinkish gray (5YR 6/2) moist; weak medium subangular blocky structure; very hard, friable, slightly sticky and slightly plastic; common very fine roots and few coarse roots; 50 percent cobbles and pebble-sized limestone fragments; accumulations of lime common on rock fragments; strongly effervescent; moderately alkaline; abrupt smooth boundary.

IIR—16 inches; fractured limestone; discontinuous cemented layer of calcium carbonate 1 to 2 centimeters thick on bedrock; many pendants on the lower side of limestone fragments.

Bedrock is at a depth of 10 to 20 inches. The solum is 10 to 35 percent coarse fragments. The A1 horizon is reddish brown or brown. The Bt horizon is reddish brown or yellowish red. It is clay loam, gravelly clay loam, clay, or gravelly clay. The Cca horizon is pinkish white, pinkish gray, or light reddish brown. It is gravelly loam, very gravelly loam, or very cobbly loam.

Cabezon series

The Cabezon series consists of shallow, well drained, slowly permeable soils on hillsides. These soils formed in alluvium and colluvium derived from basalt and pyroclastics. Slope ranges from 2 to 30 percent. The average annual precipitation is 12 to 16 inches, and the average annual air temperature is 50 to 54 degrees F.

These soils are clayey, montmorillonitic, mesic Lithic Argiustolls.

Typical pedon of a Cabezon stony clay loam in an area of Thunderbird-Cabezon complex, 2 to 30 percent slopes, about 13 miles northeast of Seligman; 2,500 feet south of the north quarter corner of sec. 11, T. 23 N., R. 5 W.

A1—0 to 3 inches; dark brown (10YR 4/3) stony clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine and fine roots and few medium roots; few fine interstitial pores; 30 percent stones; mildly alkaline; clear smooth boundary.

B21t—3 to 6 inches; brown (7.5YR 4/3) gravelly clay, dark brown (7.5YR 3/2) moist; moderate fine subangular blocky structure; very hard, very firm, sticky and plastic; many very fine and fine roots, few medium roots, and common coarse roots; common very fine tubular pores; few thin clay films on faces of peds; common pressure faces; 30 percent basalt pebbles; mildly alkaline; clear smooth boundary.

B22t—6 to 15 inches; brown (7.5YR 4/4) gravelly clay, dark brown (7.5YR 3/2) moist; moderate medium prismatic structure parting to moderate fine and medium subangular blocky; very hard, very firm, very sticky and very plastic; common very fine and fine roots, few medium roots, and common coarse roots; common very fine tubular pores; many thick clay films on faces of peds; common pressure faces; 20 percent pebbles; mildly alkaline; abrupt irregular boundary.

IIR—15 inches; fractured basalt.

About 80 to 90 percent of the surface is covered with basalt cobbles, pebbles, and stones. The thickness of the solum and depth to extremely hard basalt range from 10 to 20 inches. The A1 horizon is dark brown or very dark grayish brown. The B2t horizon is brown or dark brown. It is clay, gravelly clay, or clay loam.

Clovis series

The Clovis series consists of deep, well drained, moderately permeable soils on fan terraces. These soils

formed in mixed eolian and alluvial deposits derived from sandstone, limestone, and quartzite. Slope ranges from 1 to 8 percent. The average annual precipitation is 12 to 14 inches, and the average annual air temperature is 50 to 54 degrees F.

These soils are fine-loamy, mixed, mesic Ustollic Haplargids.

Typical pedon of Clovis loamy sand, 1 to 8 percent slopes, about 35 miles north and 20 miles west of Williams; 100 feet south and 100 feet east of the northwest corner of sec. 28, T. 27 N., R. 2 W.

A1—0 to 5 inches; reddish brown (5YR 5/4) loamy sand, reddish brown (5YR 4/4) moist; single grain; loose; common fine roots; many very fine interstitial pores; neutral; gradual smooth boundary.

B2t—5 to 17 inches; red (2.5YR 4/6) sandy clay loam, dark red (2.5YR 3/6) moist; weak coarse subangular blocky structure; slightly hard, friable, sticky and plastic; common very fine roots; common very fine interstitial pores; very few thin clay films line interstitial pores; neutral; gradual smooth boundary.

B3—17 to 35 inches; yellowish red (5YR 5/6) sandy loam, yellowish red (5YR 4/6) moist; massive; slightly hard, very friable, nonsticky and nonplastic; few very fine roots; few very fine interstitial pores; neutral; diffuse wavy boundary.

C1ca—35 to 60 inches; light reddish brown (5YR 6/4) sandy loam, reddish brown (5YR 5/4) moist; massive; slightly hard, very friable, nonsticky and nonplastic; few very fine roots; common very fine tubular pores; many medium white soft lime masses; violently effervescent; 20 percent calcium carbonate; moderately alkaline.

The solum ranges from 19 to 36 inches in thickness. It is 0 to 10 percent gravel. The A1 horizon is light brown, brown, or reddish brown. The B2t and B3 horizons are reddish brown, red, or yellowish red. The A1, B2t, and B3 horizons are neutral or mildly alkaline. The C1ca horizon is light reddish brown or pink. The calcic horizon is 15 to 25 percent calcium carbonate.

Cross series

The Cross series consists of very shallow and shallow, well drained, slowly permeable soils on plateaus and mesas. These soils formed in alluvium and colluvium derived from basalt and pyroclastics. Slope ranges from 8 to 15 percent. The average annual precipitation is 12 to 14 inches, and the average annual air temperature is 50 to 54 degrees F.

These soils are clayey, montmorillonitic, mesic Lithic Argiustolls.

Typical pedon of Cross gravelly clay loam in an area of Cross-Apache complex, 2 to 15 percent slopes, about 4 miles east of Seligman; 1,000 feet west and 1,500 feet south of the northeast corner of sec. 1, T. 22 N., R. 5 W.

A1—0 to 3 inches; dark grayish brown (10YR 4/2) gravelly clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; slightly hard, friable, sticky and plastic; few fine roots; many very fine interstitial pores; 20 percent pebbles and 5 percent cobbles; moderately alkaline; clear smooth boundary.

B1t—3 to 10 inches; dark brown (7.5YR 4/2) clay, dark brown (7.5YR 3/2) moist; weak fine subangular blocky structure; hard, firm, sticky and plastic; common very fine and fine roots; few very fine interstitial and tubular pores; very few clay films line tubular and interstitial pores; many thin clay films on faces of peds; 10 percent pebbles; mildly alkaline; gradual wavy boundary.

B2tca—10 to 14 inches; pinkish gray (7.5YR 6/2) clay, brown (7.5YR 5/4) moist; moderate fine subangular blocky structure; hard, firm, sticky and plastic; common very fine roots; few very fine interstitial and tubular pores; 10 percent lime-coated pebbles; strongly effervescent; moderately alkaline; abrupt smooth boundary.

Cca—14 to 19 inches; white (10YR 8/1) cobbly clay loam, light gray (10YR 7/1) moist; massive; slightly hard, firm, sticky and plastic; few very fine roots; few very fine tubular pores; 30 percent cobbles; violently effervescent; 60 percent calcium carbonate; moderately alkaline; abrupt irregular boundary.

IIR—19 inches; fractured basalt; common carbonates in joints.

Depth to bedrock ranges from 8 to 20 inches. The solum ranges from 6 to 18 inches in thickness. It is 5 to 35 percent coarse fragments. The A1 horizon is brown or dark grayish brown. It is gravelly clay loam or very stony clay loam. The Bt horizon is dark brown or pinkish gray. It is clay loam or clay. The Cca horizon is white or pinkish white. The calcic horizon is 15 to 60 percent calcium carbonate.

Daze series

The Daze series consists of shallow, well drained, slowly permeable soils on hillsides. These soils formed in alluvium and colluvium derived from cherty, dolomitic limestone and calcareous sandstone. Slope ranges from 2 to 30 percent. The average annual precipitation is 12 to 14 inches, and the average annual air temperature is 50 to 54 degrees F.

These soils are clayey, mixed, mesic Lithic Argiustolls.

Typical pedon of a Daze gravelly loam in an area of Daze-Deama association, moderately steep, about 16 miles north of Ashfork on the Diamond 7 Ranch; 500 feet south of the center of sec. 12, T. 24 N., R. 2 W.

A11—0 to 2 inches; brown (7.5YR 4/2) gravelly loam, dark brown (7.5YR 3/2) moist; weak fine granular structure; soft, very friable, nonsticky and nonplastic;

common fine roots; many fine interstitial pores; 20 percent chert and quartzite pebbles; neutral; clear smooth boundary.

A12—2 to 12 inches; brown (7.5YR 4/2) gravelly loam, dark brown (7.5YR 3/2) moist; weak fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; common fine tubular pores; 20 percent chert and quartzite pebbles; neutral; clear smooth boundary.

B21t—12 to 15 inches; reddish brown (5YR 4/3) gravelly clay, dark reddish brown (5YR 3/3) moist; strong fine and medium subangular blocky structure; hard, firm, sticky and plastic; common fine roots; common fine tubular pores; thin continuous clay films on faces of peds; 20 percent chert and quartzite pebbles; moderately alkaline; gradual wavy boundary.

B22t—15 to 19 inches; reddish brown (5YR 4/4) gravelly clay, dark reddish brown (5YR 3/4) moist; strong fine and medium subangular blocky structure; very hard, very firm, very sticky and very plastic; common fine roots; few fine pores; thin continuous clay films on faces of peds; 20 percent chert and quartzite pebbles; slightly effervescent; moderately alkaline; abrupt irregular boundary.

IIR—19 inches; fractured, cherty, dolomitic limestone.

Thickness of the solum and depth to bedrock range from 10 to 20 inches. The solum is 15 to 35 percent coarse fragments. It is neutral or moderately alkaline. The A1 horizon is brown or reddish brown. The B2t horizon is reddish brown or brown. It is gravelly clay loam or gravelly clay. The B2t horizon is mildly alkaline or moderately alkaline.

Deama series

The Deama series consists of very shallow and shallow, well drained, moderately permeable soils on hillsides. These soils formed in alluvium and colluvium derived from limestone and calcareous sandstone. Slope ranges from 1 to 75 percent. The average annual precipitation is 14 to 16 inches, and the average annual air temperature is 50 to 54 degrees F.

These soils are loamy-skeletal, carbonatic, mesic Lithic Calciustolls.

Typical pedon of Deama extremely stony loam in an area of Deama-Tovar association, steep, about 4.5 miles west of Seligman, along Aubrey Cliffs; 1,500 feet east and 500 feet north of the southwest corner of sec. 20, T. 23 N., R. 6 W.

A11—0 to 7 inches; brown (10YR 4/3) extremely stony loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure and moderate fine and medium granular; slightly hard, very friable, slightly sticky and slightly plastic; many very fine and fine roots; common very fine tubular pores; about 60 percent stones and 10 percent limestone cobbles and pebbles; strongly effervescent; moderately alkaline; clear smooth boundary.

A12—7 to 12 inches; brown (10YR 5/3) very cobbly loam, dark brown (10YR 3/3) moist; weak fine subangular blocky structure and moderate fine and medium granular; slightly hard, very friable, slightly sticky and slightly plastic; common very fine and fine roots; common very fine tubular pores; 40 percent limestone cobbles and 10 percent limestone pebbles; strongly effervescent; moderately alkaline; clear smooth boundary.

Cca—12 to 19 inches; light gray (10YR 7/2) very cobbly loam, pale brown (10YR 6/3) moist; weak fine subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine and fine roots; few very fine tubular pores; 50 percent cobbles and 15 percent limestone pebbles, all with thin lime coating; violently effervescent; moderately alkaline; abrupt irregular boundary.

IIR—19 inches; fractured limestone; very pale brown (10YR 8/3) loam in fractures, pale brown (10YR 6/3) moist; few fine roots in fractures; common carbonate pendants.

Depth to bedrock ranges from 6 to 20 inches. The profile averages 40 to 70 percent coarse fragments and is more than 40 percent calcium carbonate. The A horizon is brown, dark brown, or very dark grayish brown. It is extremely stony loam, gravelly loam, or stony loam. The C horizon is brown, pale brown, or light gray. It is loam and is more than 40 percent coarse fragments. Some pedons have a discontinuous cemented layer less than 1 inch thick above the limestone.

Disterheff series

The Disterheff series consists of deep, well drained, slowly permeable soils on fan terraces and hillsides. These soils formed in alluvium and colluvium derived from pyroclastics, quartzite, and basalt. Slope ranges from 0 to 15 percent. The average annual precipitation is 11 to 14 inches, and the average annual air temperature is 50 to 54 degrees F.

These soils are fine, montmorillonitic, mesic Aridic Paleustalfs.

Typical pedon of Disterheff very gravelly sandy clay loam, 1 to 15 percent slopes (fig. 2), about 4.5 miles east of Aubrey Cliffs on Rose Well Road; 2,000 feet north and 1,800 feet west of the southeast corner of sec. 5, T. 25 N., R. 6 W.

A11—0 to 2 inches; brown (10YR 5/3) very gravelly sandy clay loam, dark brown (7.5YR 3/4) moist; moderate fine and medium granular structure; slightly hard, very friable, sticky and slightly plastic; many very fine roots; common very fine interstitial pores; 40 percent pebbles; neutral; clear smooth boundary.

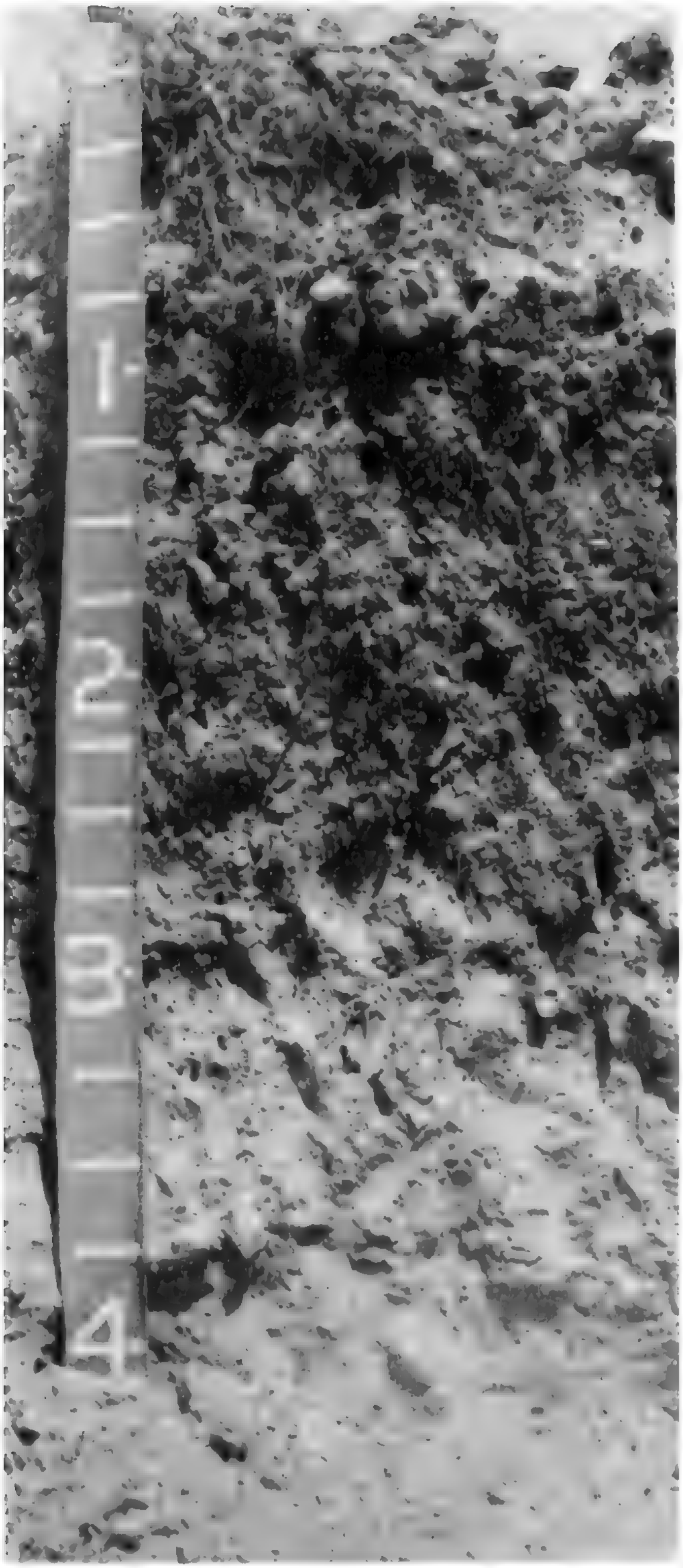

Figure 2.—Profile of Disterheff very gravelly sandy clay loam, 1 to 15 percent slopes.

A12—2 to 6 inches; brown (7.5YR 4/4) gravelly clay loam, dark brown (7.5YR 3/4) moist; moderate fine subangular blocky structure; hard, friable, sticky and plastic; many very fine roots; common very fine tubular pores; 20 percent pebbles; mildly alkaline; clear smooth boundary.

IIB21t—6 to 11 inches; dark reddish brown (5YR 3/4) gravelly clay, dark reddish brown (5YR 3/4) moist; moderate fine and medium subangular blocky structure; hard, friable, sticky and plastic; many very fine roots; common very fine tubular pores; common small pressure faces; 20 percent pebbles; mildly alkaline; clear smooth boundary.

IIB22t—11 to 24 inches; dark red (2.5YR 3/6) clay, dark red (2.5YR 3/6) moist; strong medium prismatic structure parting to strong medium blocky; very hard, very firm, very sticky and very plastic; common very fine roots and few medium and coarse roots; common very fine tubular pores; common small pressure faces; 10 percent pebbles; mildly alkaline; clear wavy boundary.

IIIB3tca—24 to 30 inches; red (2.5YR 5/6) very gravelly clay loam, red (2.5YR 4/6) moist; weak fine subangular blocky structure; very hard, very firm, very sticky and very plastic; few very fine and coarse roots; few to common very fine and fine tubular pores; few thin clay films on faces of peds and lining pores; common small pressure faces; common soft medium and large irregularly shaped lime masses; 40 percent pebbles and 10 percent cobbles, all partially coated with lime; strongly effervescent lime masses; moderately alkaline; clear wavy boundary.

IIICca—30 to 60 inches; white (7.5YR 8/2) very cobbly clay loam, brownish yellow (7.5YR 6/6) moist; massive; very hard, very firm, sticky and plastic; about 30 percent cobbles and 30 percent pebbles, all partially coated with lime; 30 percent calcium carbonate; violently effervescent; moderately alkaline.

Thickness of the solum and depth to the calcic horizon range from 20 to 36 inches. The solum is 10 to 30 percent coarse fragments. The A horizon is light brown or yellowish brown. It is very gravelly sandy clay loam, cobbly loam, or cobbly sandy clay loam. The B2t horizon is dark reddish brown or dark red. It is clay loam, clay, cobbly clay, or gravelly clay. The C1ca horizon is pinkish white, pink, or light reddish brown. It is very gravelly clay loam or very cobbly clay loam. The calcic horizon is 15 to 40 percent calcium carbonate.

Epikom series

The Epikom series consists of shallow, well drained, moderately permeable soils on plateaus and mesas. These soils formed in alluvial and eolian deposits derived from calcareous sandstone and sandy shale and

pyroclastics. Slope ranges from 0 to 15 percent. The average annual precipitation is 6 to 10 inches, and the average annual air temperature is 52 to 55 degrees F.

These soils are loamy, mixed, mesic Lithic Camborthids.

Typical pedon of an Epikom fine sandy loam in an area of Epikom complex, 0 to 15 percent slopes, about 48 miles east and 18 miles south of Flagstaff; 600 feet west of the center of sec. 32, T. 18 N., R. 14 E.

A1—0 to 3 inches; reddish brown (5YR 5/4) fine sandy loam, reddish brown (5YR 4/4) moist; weak thin platy structure; slightly hard, very friable, slightly sticky and slightly plastic; few fine roots; common fine vesicular pores and many interstitial pores; strongly effervescent; moderately alkaline; abrupt smooth boundary.

B2—3 to 15 inches; reddish yellow (5YR 6/6) gravelly loam, yellowish red (5YR 5/6) moist; weak fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and plastic; common fine and medium roots; few interstitial and tubular pores; 20 percent pebbles; violently effervescent; moderately alkaline; abrupt wavy boundary.

IIR—15 inches; fractured sandstone; common calcium carbonate in joints.

Depth to bedrock ranges from 10 to 20 inches. The profile is 0 to 30 percent coarse fragments. The profile is red, reddish, brown, brown, light brown, light red, or reddish yellow. The A1 horizon is fine sandy loam, gravelly fine sandy loam, or very cindery loamy sand. It is mildly alkaline or moderately alkaline. The B2 horizon is loam or gravelly loam. It is moderately alkaline or strongly alkaline. The R horizon is highly fractured sandstone to alternating layers of sandstone, shale, and sandy shale with thin seams of gypsum.

Faraway series

The Faraway series consists of very shallow and shallow, well drained, moderately permeable soils on hillsides. These soils formed in alluvium and colluvium derived from rhyodacite and andesite. Slope ranges from 20 to 80 percent. The average annual precipitation is 14 to 18 inches, and the average annual air temperature is 50 to 54 degrees F.

These soils are loamy-skeletal, mixed, mesic Lithic Haplustolls.

Typical pedon of a Faraway very gravelly loam in an area of Faraway-Rock outcrop complex, 20 to 80 percent slopes, about 500 feet east of radio facility on Mount Floyd; 500 feet north and 2,000 feet west of the east quarter corner of sec. 17, T. 23 N., R. 4 W.

A11—0 to 1 inch; grayish brown (10YR 5/2) very gravelly loam, very dark grayish brown (10YR 3/2) moist; weak thin platy structure parting to weak very fine granular; slightly hard, very friable, slightly sticky and slightly plastic; many very fine and fine roots; few very fine interstitial pores; 20 percent cobbles and 40 percent fine pebbles; neutral; abrupt smooth boundary.

A12—1 inch to 7 inches; dark grayish brown (10YR 4/2) very gravelly loam, very dark grayish brown (10YR 3/2) moist; weak to moderate fine subangular blocky structure; slightly hard, very friable, sticky and slightly plastic; many very fine and fine roots; few fine interstitial pores; 40 percent fine pebbles; neutral; clear smooth boundary.

B2—7 to 13 inches; brown (10YR 5/3) very gravelly loam, dark brown (10YR 4/3) moist; weak to moderate fine subangular blocky structure; slightly hard, very friable, sticky and slightly plastic; many very fine and fine roots and few medium roots; few fine interstitial pores; 40 percent fine pebbles; mildly alkaline; abrupt wavy boundary.

IIR—13 inches; fractured extremely hard rhyodacite.

Depth to bedrock ranges from 5 to 20 inches. The profile is 35 to 60 percent coarse fragments. It is neutral or mildly alkaline. The A1 horizon is grayish brown or dark grayish brown. The B horizon is brown or dark brown. It is very gravelly loam or very cobbly loam.

Ives series

The Ives series consists of deep, well drained, moderately permeable soils on alluvial fans and flood plains. These soils formed in mixed alluvium. Slope ranges from 0 to 8 percent. The average annual precipitation is 6 to 10 inches, and the average annual air temperature is 52 to 55 degrees F.

These soils are coarse-loamy, mixed (calcareous), mesic Typic Torrifluvents.

Typical pedon of an Ives sandy loam in an area of Tours-Ives association, gently sloping, about 10 miles west of Winslow and 1/4 mile north of the Turquoise Ranch headquarters; 750 feet north and 750 feet east of the west quarter corner of sec. 1, T. 19 N., R. 14 E.

A1—0 to 3 inches; reddish brown (5YR 5/4) sandy loam, reddish brown (5YR 4/4) moist; single grain, but with a thin weak surface crust; loose; common very fine and fine roots; slightly effervescent; moderately alkaline; clear smooth boundary.

C1—3 to 15 inches; reddish brown (5YR 4/4) fine sandy loam, dark reddish brown (5YR 3/4) moist; massive; hard, very friable, slightly sticky and nonplastic; few fine and medium roots; few very fine and fine tubular and interstitial pores; slightly effervescent; moderately alkaline; gradual smooth boundary.

C2—15 to 38 inches; reddish brown (5YR 5/4) fine sandy loam, reddish brown (5YR 4/4) moist; massive; hard, very friable, slightly sticky and nonplastic; few fine and medium roots; common

very fine and fine tubular pores; common fine lime filaments; thin stratum of sandy clay loam about 3 inches thick; slightly effervescent; moderately alkaline; gradual smooth boundary.

C3—38 to 60 inches; reddish brown (5YR 5/4) sandy loam stratified with thin layers of fine sandy loam and gravelly sandy loam, reddish brown (5YR 4/4) moist; massive; slightly hard, very friable, slightly sticky and nonplastic; few very fine and fine tubular pores; slightly effervescent; moderately alkaline.

The profile is 60 inches deep or more. It is noneffervescent to violently effervescent and is mildly alkaline or moderately alkaline throughout. The profile is light reddish brown or reddish brown. The C horizon is fine sandy loam or sandy loam and has thin strata of sandy clay loam, loam, gravelly sandy loam, and loamy fine sand 1/8 inch to 4 inches thick.

Keeseha series

The Keeseha series consists of deep, well drained, slowly permeable soils on fan terraces. These soils formed in alluvium derived from sandstone, limestone, shale, and quartzite. Slope ranges from 0 to 8 percent. The average annual precipitation is 12 to 14 inches, and the average annual air temperature is 52 to 54 degrees F.

These soils are fine, mixed, mesic Ustollic Haplargids.

Typical pedon of a Keeseha gravelly sandy loam in an area of Keeseha-Poley gravelly sandy loams, 0 to 8 percent slopes, about 4.5 miles north of U.S. Highway 66 in Aubrey Valley; 900 feet west and 1,300 feet north of the southeast corner of sec. 16, T. 25 N., R. 8 W.

A11—0 to 2 inches; brown (7.5YR 5/4) gravelly sandy loam, dark brown (7.5YR 4/4) moist; moderate fine granular structure; slightly hard, very friable, nonsticky and nonplastic; common fine roots; few very fine tubular pores; 30 percent fine pebbles; neutral; clear smooth boundary.

A12—2 to 4 inches; brown (7.5YR 4/4) sandy clay loam, reddish brown (5YR 4/4) moist; moderate fine subangular blocky structure and weak fine and medium granular; slightly hard, very friable, slightly sticky and slightly plastic; many very fine and fine roots; few very fine tubular pores; mildly alkaline; clear smooth boundary.

IIB2t—4 to 13 inches; yellowish red (5YR 4/6) clay, yellowish red (5YR 4/6) moist; weak to moderate medium prismatic structure parting to moderate fine and medium subangular blocky; hard, firm, very sticky and very plastic; common very fine roots; few very fine tubular pores; common to many thin clay films on faces of peds, bridging sand grains, and in pores; 10 percent fine pebbles; mildly alkaline; clear smooth boundary.

IIIC1ca—13 to 20 inches; yellowish red (5YR 5/6) gravelly sandy clay loam, strong brown (7.5YR 5/6) moist; massive; hard, friable, sticky and plastic; common very fine roots; few very fine interstitial pores; 20 percent fine pebbles; strongly effervescent; moderately alkaline; abrupt irregular boundary.

IIIC2ca—20 to 60 inches; pinkish white (7.5YR 8/2) very gravelly sandy loam, reddish yellow (7.5YR 8/6) moist; massive; slightly hard to hard, friable, slightly sticky and nonplastic; common very fine roots and few fine roots; common very fine and fine tubular pores; 40 percent very fine and fine pebbles; violently effervescent; moderately alkaline.

Thickness of the solum ranges from 8 to 20 inches. The A horizon is brown, dark brown, or reddish brown. It is neutral or mildly alkaline. The B2t horizon is yellowish red or reddish yellow. It is clay or gravelly clay and is mildly alkaline or moderately alkaline. The Cca horizon is yellowish red to pinkish white. It is gravelly clay loam, clay loam, gravelly loam, very gravelly sandy loam, or gravelly sandy loam, and it is more than 15 percent calcium carbonate.

Kopie series

The Kopie series consists of shallow, well drained, moderately permeable soils on plateaus and mesas. These soils formed in eolian deposits underlain by alluvium derived dominantly from sandstone and calcareous sandy shale. Slope ranges from 1 to 15 percent. The average annual precipitation is 12 to 14 inches, and the average annual air temperature is 49 to 54 degrees F.

These soils are loamy, mixed, mesic Lithic Ustochrepts.

Typical pedon of a Kopie gravelly fine sandy loam in an area of Kopie-Servilleta association, moderately sloping, about 1/2 mile north and 1/2 mile east of junction of Arizona Highway 64 and U.S. Highway 180; 2,500 feet east and 400 feet south of the northwest corner of sec. 12, T. 26 N., R. 2 E.

A11—0 to 2 inches; yellowish red (5YR 6/4) gravelly fine sandy loam, dark reddish brown (5YR 3/4) moist; moderate fine and medium granular structure; soft, loose, nonsticky and slightly plastic; few very fine and fine roots; many interstitial pores; 20 percent pebbles; strongly effervescent; moderately alkaline; clear smooth boundary.

A12—2 to 6 inches; reddish brown (5YR 5/4) loam, dark reddish brown (2.5YR 3/4) moist; weak medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; few very fine and fine roots; few very fine tubular pores; 10 percent pebbles; strongly effervescent; moderately alkaline; clear wavy boundary.

B2ca—6 to 14 inches; light reddish brown (5YR 5/4) channery loam, reddish brown (5YR 4/4) moist;

weak fine subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; few very fine and fine roots; 30 percent channery fragments of shale and sandstone; violently effervescent; moderately alkaline; clear wavy boundary.

R—14 inches; fractured calcareous sandstone; common carbonate coatings in joints.

Depth to bedrock ranges from 10 to 20 inches. The profile is 5 to 35 percent coarse fragments. The A horizon is yellowish red or reddish brown. The cambic B2 horizon is reddish brown or light reddish brown. It is channery loam, gravelly loam, or loam.

Lomaki series

The Lomaki series consists of deep, well drained, moderately permeable soils on dissected fan terraces and hillsides. These soils formed in alluvium derived from pyroclastics. Slope ranges from 0 to 8 percent. The average annual precipitation is 8 to 14 inches, and the average annual air temperature is 52 to 55 degrees F.

These soils are cindery, mesic Aridic Haplustolls.

Typical pedon of a Lomaki very cindery loam in an area of Lomaki-Nalaki very cindery loams, 0 to 8 percent slopes, about 25 miles north of Flagstaff on the CO-Bar ranch; 2,100 feet west and 2,100 feet south of the northeast corner of sec. 30, T. 26 N., R. 8 E.

A11—0 to 3 inches; brown (10YR 5/3) very cindery loam, dark brown (7.5YR 3/2) moist; moderate thick platy structure; soft, very friable, slightly sticky and nonplastic; many fine, medium, and coarse roots; many very fine and fine vesicular pores; 60 percent cinders; moderately alkaline; clear smooth boundary.

A12—3 to 8 inches; grayish brown (10YR 5/2) very cindery loam, dark brown (7.5YR 3/2) moist; weak fine and medium subangular blocky and granular structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine roots; few very fine and fine tubular pores and common fine interstitial pores; 40 percent cinders; moderately alkaline; clear wavy boundary.

B21ca—8 to 14 inches; light yellowish brown (10YR 6/4) very cindery loam, dark yellowish brown (10YR 3/4) moist; weak very fine and fine granular structure; soft, very friable, slightly sticky and nonplastic; many fine roots; few very fine and fine tubular pores and common fine interstitial pores; 50 percent lime-coated cinders; strongly effervescent; moderately alkaline; clear wavy boundary.

B22ca—14 to 24 inches; pale brown (10YR 6/3) extremely cindery loam, dark yellowish brown (10YR 4/4) moist; massive; soft, very friable, slightly sticky and nonplastic; many very fine and fine roots; common very fine and fine tubular pores; 65 percent lime-coated cinders; violently effervescent; moderately alkaline; clear wavy boundary.

IIC—24 to 60 inches; black (10YR 2/1) cinders, dark gray (10YR 4/1) moist; single grain; cinders in upper 15 to 20 inches have coating of lime, decreasing with depth; strongly effervescent; moderately alkaline.

About 60 percent of the surface is covered with cinder gravel that is mostly 2 to 76 millimeters in diameter. Thickness of the solum and depth to the cinders range from 20 to 40 inches. The solum is 35 to 75 percent cinders. The A1 horizon is brown or grayish brown. The B2ca horizon is pale brown or light yellowish brown. The IIC horizon is dark gray or black.

Lynx series

The Lynx series consists of deep, well drained, moderately slowly permeable soils on stream terraces and alluvial fans. These soils formed in mixed alluvium. Slope ranges from 0 to 8 percent. The average annual precipitation is 12 to 16 inches, and the average annual air temperature is 50 to 54 degrees F.

These soils are fine-loamy, mixed, mesic Cumulic Haplustolls.

Typical pedon of a Lynx loam in an area of Paymaster-Lynx association, gently sloping, about 15 miles north of Ashfork; 2,500 feet west and 1,000 feet south of the east quarter corner of sec. 27, T. 24 N., R. 2 W.

A11—0 to 2 inches; brown (7.5YR 4/2) loam, dark brown (7.5YR 3/2) moist; weak thin platy structure parting to weak fine granular; soft, very friable, slightly sticky and nonplastic; many fine roots; many fine interstitial pores; mildly alkaline; clear smooth boundary.

A12—2 to 7 inches; brown (7.5YR 4/2) clay loam, dark brown (7.5YR 3/2) moist; weak fine subangular blocky structure parting to weak fine granular; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; common fine tubular pores; mildly alkaline; gradual wavy boundary.

A13—7 to 22 inches; brown (7.5YR 4/2) clay loam, dark brown (7.5YR 3/2) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; few fine interstitial pores and common fine tubular pores; strongly effervescent; moderately alkaline; gradual wavy boundary.

A14—22 to 36 inches; brown (7.5YR 4/2) clay loam, dark brown (7.5YR 3/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; few fine interstitial pores and common fine tubular pores; strongly effervescent; moderately alkaline; gradual wavy boundary.

C—36 to 60 inches; reddish brown (5YR 4/3) clay loam, dark reddish brown (5YR 3/3) moist; massive; hard, firm, sticky and plastic; few very fine roots; few fine

interstitial and tubular pores; strongly effervescent; moderately alkaline.

The mollic epipedon is 20 to 40 inches or more in thickness. The control section is loam or clay loam and averages less than 15 percent coarse fragments. It is neutral to moderately alkaline throughout. Lime filaments are in the lower part in some pedons. The profile is brown, dark brown, or reddish brown.

The Lynx soils in this survey area are a taxadjunct to the Lynx series because they have carbonates throughout the 10- to 40-inch control section. This difference, however, does not significantly affect use and management.

Mespun series

The Mespun series consists of deep, excessively drained, rapidly permeable soils on fan terraces. These soils formed in water-worked eolian deposits derived from sandstone, shale, and quartzite. Slope ranges from 1 to 8 percent. The average annual precipitation is 12 to 14 inches, and the average annual air temperature is 52 to 54 degrees F.

These soils are mixed, mesic Ustic Torripsamments.

Typical pedon of a Mespun loamy sand in an area of Mespun-Palma complex, 1 to 8 percent slopes, about 5.75 miles north of U.S. Highway 66 in Aubrey Valley; 1,500 feet west and 1,100 feet north of the southeast corner of sec. 10, T. 25 N., R. 8 W.

A1—0 to 4 inches; brown (7.5YR 5/4) loamy sand, dark brown (7.5YR 4/4) moist; weak fine granular structure; soft, very friable, nonsticky and nonplastic; many very fine and common fine roots; few very fine and coarse tubular pores; moderately alkaline; clear smooth boundary.

C1—4 to 13 inches; reddish brown (5YR 5/4) loamy sand, dark reddish brown (5YR 3/4) moist; massive; soft, very friable, nonsticky and nonplastic; common very fine roots; few very fine and coarse tubular pores; moderately alkaline; clear smooth boundary.

C2—13 to 60 inches; reddish yellow (7.5YR 6/6) loamy sand, yellowish red (5YR 5/6) moist; single grain; loose; few fine and medium roots; few very fine and coarse tubular pores; moderately alkaline.

The profile is 60 inches or more in thickness. It is sand, loamy sand, or loamy fine sand and is mildly alkaline or moderately alkaline. The A1 horizon is brown or dark brown. The C horizon is reddish brown, reddish yellow, or yellowish red.

Nalaki series

The Nalaki series consists of moderately deep, well drained, moderately permeable soils on fan terraces. These soils formed in alluvium derived from pyroclastics. Slope ranges from 0 to 8 percent. The average annual precipitation is 8 to 14 inches, and the average annual air temperature is 52 to 55 degrees F.

These soils are cindery, mesic Aridic Durustolls.

Typical pedon of a Nalaki very cindery loam in an area of Lomaki-Nalaki very cindery loams, 0 to 8 percent slopes, about 28 miles north of Flagstaff; 1,000 feet east and 1,500 feet south of the northwest corner of sec. 35, T. 26 N., R. 7 E.

A11—0 to 3 inches; brown (10YR 5/3) very cindery loam, dark brown (7.5YR 3/2) moist; moderate medium platy structure; slightly hard, very friable, slightly sticky and slightly plastic; few fine roots; many very fine and fine vesicular and interstitial pores; 40 percent cinders; moderately alkaline; clear smooth boundary.

A12—3 to 10 inches; brown (10YR 5/3) very cindery loam, dark brown (7.5YR 3/2) moist; weak fine granular structure; soft, very friable, slightly sticky and slightly plastic; few very fine and fine roots; few fine tubular and interstitial pores; 35 percent cinders; moderately alkaline; clear wavy boundary.

B21—10 to 14 inches; pale brown (10YR 6/3) extremely cindery loam, dark brown (7.5YR 3/2) moist; weak fine subangular blocky structure parting to weak fine granular; soft, very friable, slightly sticky and slightly plastic; common very fine and fine roots; many fine tubular and interstitial pores; 65 percent lime-coated cinders; strongly effervescent; moderately alkaline; clear wavy boundary.

B22ca—14 to 21 inches; light yellowish brown (10YR 6/4) extremely cindery loam, dark grayish brown (7.5YR 4/2) moist; weak fine subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; common very fine and fine roots; many fine tubular and interstitial pores; 65 percent lime-coated cinders; violently effervescent; moderately alkaline; abrupt smooth boundary.

IIC1sicam—21 to 27 inches; pinkish white (7.5YR 8/2) silica- and lime-cemented pan, pink (7.5YR 7/4) moist; massive with thin laminar surface and pendants on underside of pan; violently effervescent; moderately alkaline; abrupt smooth boundary.

IIIC2—27 to 60 inches; very pale brown (10YR 7/3) cinders, brown (7.5YR 5/4) moist; single grain; loose; lime coatings on some of the cinders; common thin discontinuous weakly cemented strata.

About 60 percent of the surface is covered with cinder gravel that is mostly 2 to 76 millimeters in diameter. Thickness of the solum and depth to the duripan range from 20 to 40 inches. The solum is 35 to 70 percent cinders. The A horizon is brown, dark brown, or grayish brown. The B2 horizon is pale brown or light yellowish brown. It is very cindery loam or extremely cindery loam. The C1sicam horizon is white, pale brown, pinkish white,

pinkish gray, strong brown, or pink. The IIIC horizon is very pale brown or black.

Navajo series

The Navajo series consists of deep, well drained, very slowly permeable soils on flood plains and in basins. These soils formed in mixed alluvium. Slope ranges from 0 to 5 percent. The average annual precipitation is 6 to 10 inches, and the average annual air temperature is 52 to 55 degrees F.

These soils are fine, mixed (calcareous), mesic Vertic Torrifluvents.

Typical pedon of Navajo clay, 0 to 5 percent slopes, about 53 miles east of Flagstaff and about 5 miles north of Interstate 40; 250 feet east and 2,000 feet north of the south quarter corner of sec. 6, T. 20 N., R. 15 E.

A11—0 to 1 inch; reddish brown (5YR 5/4) clay, reddish brown (5YR 4/4) moist; moderate fine and medium platy structure; slightly hard, very friable, sticky and plastic; few very fine and fine vesicular pores and few very fine tubular pores; slightly effervescent; moderately alkaline; abrupt smooth boundary.

A12—1 inch to 6 inches; reddish brown (2.5YR 4/4) clay, dark reddish brown (2.5YR 3/4) moist; weak very fine subangular blocky structure appearing massive in place; hard, firm, sticky and plastic; few very fine and fine tubular pores; slightly effervescent; moderately alkaline; clear smooth boundary.

A13—6 to 14 inches; reddish brown (2.5YR 4/4) clay, dark reddish brown (2.5YR 3/4) moist; weak fine and medium subangular blocky structure appearing massive in place; very hard, very firm, very sticky and very plastic; very few fine tubular pores; few small slickensides; few very fine segregations of soft lime; slightly effervescent; moderately alkaline; gradual wavy boundary.

C1—14 to 32 inches; reddish brown (2.5YR 4/4) clay, dark red (2.5YR 3/6) moist; massive; very hard, firm, very sticky and very plastic; few small slickensides; many lime filaments and soft lime segregations; slightly effervescent; moderately alkaline; gradual wavy boundary.

C2—32 to 60 inches; reddish brown (2.5YR 5/4) clay, reddish brown (2.5YR 4/4) moist; massive; very hard, firm, very sticky and very plastic; few small slickensides; slightly effervescent; moderately alkaline.

The profile is 60 inches or more in thickness. The C horizon is dominantly clay, but it is silty clay in some pedons.

Palma series

The Palma series consists of deep, well drained, moderately rapidly permeable soils on fan terraces. These soils formed in wind-worked mixed alluvium. Slope ranges from 0 to 5 percent. The average annual precipitation is 12 to 14 inches, and the average annual air temperature is 52 to 54 degrees F.

These soils are coarse-loamy, mixed, mesic Ustollic Haplargids.

Typical pedon of Palma sandy loam, 0 to 5 percent slopes, about 1,500 feet north of U.S. Highway 66 in Aubrey Valley; 2,640 feet south and 1,700 feet east of the northwest corner of sec. 15, T. 24 N., R. 8 W.

A1—0 to 6 inches; brown (7.5YR 5/4) sandy loam, reddish brown (5YR 4/4) moist; weak fine and medium granular structure; soft, very friable, nonsticky and nonplastic; many very fine and fine roots; few very fine interstitial pores; neutral; clear smooth boundary.

B2t—6 to 20 inches; yellowish red (5YR 4/6) sandy loam, yellowish red (5YR 4/6) moist; moderate coarse prismatic structure and weak fine subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; many very fine roots; many very fine and fine tubular pores; few thin clay films lining pores and bridging grains; mildly alkaline; clear smooth boundary.

B3—20 to 38 inches; yellowish red (5YR 5/6) sandy loam, yellowish red (5YR 4/6) moist; massive; hard, very friable, slightly sticky and nonplastic; many very fine roots; many very fine and fine tubular pores; mildly alkaline; clear smooth boundary.

C1ca—38 to 44 inches; yellowish red (5YR 5/6) sandy loam, yellowish red (5YR 4/6) moist; massive; hard, very friable, nonsticky and nonplastic; common very fine roots; common very fine and fine tubular pores; common to many thin pinkish white (5YR 8/2) and pink (5YR 7/4) lime threads; strongly effervescent; mildly alkaline; clear smooth boundary.

C2—44 to 60 inches; yellowish red (5YR 5/8) sandy loam, yellowish red (5YR 4/6) moist; massive; slightly hard, very friable, nonsticky and nonplastic; common very fine roots; few very fine pores; mildly alkaline.

The solum ranges from 15 to 38 inches in thickness. It is neutral to moderately alkaline. The A1 horizon is brown or reddish brown. Lime segregations are present in the Cca horizon in some pedons.

Pastura series

The Pastura series consists of very shallow and shallow, well drained, moderately permeable soils on fan terraces and hillsides. These soils formed in alluvium and colluvium derived from limestone, sandstone, and pyroclastics. Slope ranges from 0 to 15 percent. The average annual precipitation is 12 to 14 inches, and the average annual air temperature is 50 to 54 degrees F.

These soils are loamy, mixed, mesic, shallow Ustollic Paleorthids.

Typical pedon of Pastura gravelly loam, 0 to 8 percent slopes, about 1 mile west and 1 mile north of Seligman; 1,500 feet north and 700 feet west of the south quarter corner of sec. 26, T. 23 N., R. 6 W.

A11—0 to 2 inches; brown (10YR 5/3) gravelly loam, dark yellowish brown (10YR 4/4) moist; weak fine and medium granular structure; soft, very friable, slightly sticky and slightly plastic; many very fine and fine roots; few very fine tubular pores; 25 percent pebbles and hardened lime fragments; 25 percent calcium carbonate; strongly effervescent; moderately alkaline; clear smooth boundary.

A12—2 to 6 inches; brown (10YR 4/3) loam, dark brown (10YR 3/3) moist; weak fine and medium granular structure; soft, very friable, slightly sticky and slightly plastic; many very fine and fine roots; few very fine tubular pores; 15 percent calcium carbonate; 10 to 15 percent pebble-sized hardened lime fragments; strongly effervescent; moderately alkaline; clear smooth boundary.

C1ca—6 to 11 inches; very pale brown (10YR 8/3) gravelly loam, light brown (7.5YR 6/4) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; common very fine roots; 45 percent calcium carbonate; 30 percent pebble-sized hardened lime fragments; strongly effervescent; moderately alkaline; abrupt smooth boundary.

IIC2cam—11 to 32 inches; pinkish white (7.5YR 8/2) indurated lime-cemented hardpan with a laminar surface, pink (7.5YR 7/4) moist; hard platelike layers, 1 inch to 3 inches thick, that become softer with depth; violently effervescent; moderately alkaline; clear wavy boundary.

C3ca—32 to 60 inches; pinkish white (7.5YR 8/2) soft to weakly cemented platy caliche, pink (7.5YR 7/4) moist; laminar surface on some of the harder plates; violently effervescent; moderately alkaline.

Depth to the petrocalcic horizon ranges from 6 to 20 inches. Content of coarse fragments of very hard caliche, limestone, sandstone, or chert on the surface and throughout the profile averages less than 35 percent. The A horizon is brown or grayish brown. The C horizon is light brown, very pale brown, or pinkish gray. It is gravelly loam or gravelly clay loam. The Ccam horizon is 6 to 36 inches thick.

Paymaster series

The Paymaster series consists of deep, well drained, moderately permeable soils on alluvial fans and stream terraces. These soils formed in mixed alluvium. Slope ranges from 0 to 8 percent. The average annual precipitation is 12 to 16 inches, and the average annual air temperature is 50 to 54 degrees F.

These soils are coarse-loamy, mixed, mesic Cumulic Haplustolls.

Typical pedon of a Paymaster sandy loam in an area of Paymaster-Lynx association, gently sloping, about 7 miles west and 7 miles south of Valle; 1,500 feet east and 500 feet south of the northwest corner of sec. 22, T. 25 N., R. 1 E.

A11—0 to 1 inch; brown (10YR 5/3) sandy loam, very dark grayish brown (10YR 3/2) moist; weak thin platy structure; slightly hard, very friable, nonsticky and nonplastic; common fine roots; many very fine and fine vesicular pores; about 10 percent fine pebbles; neutral; abrupt smooth boundary.

A12—1 inch to 6 inches; brown (10YR 5/3) sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable, nonsticky and nonplastic; many very fine and fine roots; common very fine and fine interstitial pores; 10 percent fine pebbles; neutral; clear smooth boundary.

A13—6 to 14 inches; brown (10YR 5/3) loam, very dark grayish brown (10YR 3/2) moist; massive; slightly hard, very friable, slightly sticky and nonplastic; few fine roots; common very fine and fine tubular pores; 10 percent fine pebbles; neutral; clear smooth boundary.

A14—14 to 30 inches; brown (10YR 5/3) loam, very dark grayish brown (10YR 3/2) moist; massive; slightly hard, very friable, slightly sticky and nonplastic; few fine roots; common fine tubular pores; 10 percent fine pebbles; neutral; clear smooth boundary.

C1—30 to 42 inches; yellowish brown (10YR 5/4) loam, very dark grayish brown (10YR 3/2) moist; massive; soft, very friable, slightly sticky and nonplastic; common fine tubular pores; 10 percent fine pebbles; neutral; clear smooth boundary.

C2—42 to 60 inches; yellowish brown (10YR 5/4) gravelly sandy loam, very dark grayish brown (10YR 3/2) moist; massive; soft, very friable, nonsticky and nonplastic; 30 percent fine pebbles; neutral.

The mollic epipedon is 20 to 40 inches or more in thickness. The control section averages 5 to 20 percent coarse fragments. Reaction ranges from neutral to moderately alkaline. The A and C horizons are brown or dark brown.

Poley series

The Poley series consists of deep, well drained, slowly permeable soils on fan terraces. These soils formed in alluvium derived from sandstone, limestone, shale, and quartzite. Slope ranges from 0 to 8 percent. The average annual precipitation is 12 to 14 inches, and the average annual air temperature is 50 to 54 degrees F.

These soils are fine, mixed, mesic Ustollic Haplargids.

Typical pedon of Poley gravelly loam, 0 to 8 percent slopes, about 40 miles north of Ashfork; 100 feet south and 100 feet west of the northeast corner of sec. 33, T. 28 N., R. 2 W.

A1—0 to 4 inches; light brown (7.5YR 6/4) gravelly loam, dark brown (7.5YR 4/4) moist; weak medium platy structure parting to weak fine granular; soft, very friable, slightly sticky and nonplastic; common fine roots; many very fine vesicular and interstitial pores; 30 percent pebbles; slightly acid; clear smooth boundary.

B1t—4 to 10 inches; reddish brown (5YR 5/4) clay loam, reddish brown (5YR 4/4) moist; weak fine subangular blocky structure; slightly hard, friable, sticky and plastic; common very fine and fine roots; common fine tubular and interstitial pores; few thin clay films line tubular and interstitial pores; 10 percent pebbles; neutral; clear smooth boundary.

B21t—10 to 13 inches; yellowish red (5YR 5/6) clay, yellowish red (5YR 4/6) moist; moderate medium prismatic structure parting to moderate fine subangular blocky; very hard, very firm, sticky and plastic; common very fine and fine roots; few fine tubular and interstitial pores; common moderately thick clay films on faces of peds; 10 percent pebbles; moderately alkaline; diffuse irregular boundary.

B22tca—13 to 22 inches; yellowish red (5YR 5/6) clay, yellowish red (5YR 4/6) moist; moderate medium prismatic structure parting to moderate fine subangular blocky; very hard, very firm, sticky and plastic; common very fine and fine roots; few fine tubular and interstitial pores; common moderately thick clay films on faces of peds; few fine irregularly shaped pink soft lime masses; 10 percent pebbles; violently effervescent; moderately alkaline; abrupt irregular boundary.

C1ca—22 to 40 inches; pink (7.5YR 8/4) gravelly loam, pink (7.5YR 7/4) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; few very fine tubular pores; 25 percent pebbles; violently effervescent; 30 percent calcium carbonate; moderately alkaline; gradual wavy boundary.

IIC2—40 to 60 inches; yellowish red (5YR 5/6) very gravelly sandy loam, yellowish red (5YR 4/6) moist; massive; slightly hard, very friable, nonsticky and nonplastic; few very fine roots; common fine interstitial pores; 50 percent pebbles; slightly effervescent; moderately alkaline.

Depth to the calcic horizon ranges from 20 to 36 inches. The A1 horizon is light brown or reddish brown. It is sandy loam, gravelly loam, or gravelly sandy loam and is slightly acid or neutral. The B2t horizon is reddish brown or yellowish red. It ranges from clay loam to clay. The C horizon is gravelly loam, very gravelly loam, or very gravelly sandy loam. The calcic horizon is 20 to 50 percent calcium carbonate.

Purgatory series

The Purgatory series consists of moderately deep, well drained, moderately permeable soils on plateaus and mesas. These soils formed in eolian deposits underlain by alluvium derived from gypsiferous sandy shale. Slope ranges from 0 to 8 percent. The average annual precipitation is 6 to 8 inches, and the average annual air temperature is 52 to 55 degrees F.

These soils are fine-loamy, gypsic, mesic Typic Gypsiorthids.

Typical pedon of Purgatory gravelly fine sandy loam, 0 to 8 percent slopes, about 50 miles east of Flagstaff and about 2 miles north of Interstate 40 on Leupp Road; 250 feet south and 2,000 feet west of the northeast corner of sec. 33, T. 20 N., R. 14 E.

A1—0 to 2 inches; yellowish red (5YR 5/6) gravelly fine sandy loam, yellowish red (5YR 4/6) moist; weak thick platy structure; slightly hard, very friable, nonsticky and nonplastic; few fine, medium, and coarse roots; many very fine vesicular pores; 30 percent fine pebbles; strongly effervescent; moderately alkaline; abrupt smooth boundary.

IIC1cs—2 to 14 inches; variegated pink (5YR 8/3) and yellowish red (5YR 5/6) sandy loam, pink (5YR 7/3) and yellowish red (5YR 4/6) moist; massive; soft, very friable, nonsticky and nonplastic; few very fine and fine roots; common very fine and fine tubular pores; 10 percent soft shale fragments; slightly effervescent; moderately alkaline; abrupt wavy boundary.

IIC2cs—14 to 26 inches; light gray (N 7/0) clay loam, gray (N 5/0) moist; massive; hard, very friable, slightly sticky and slightly plastic; few fine roots; few very fine tubular pores; 10 percent soft shale fragments; slightly effervescent; moderately alkaline; clear smooth boundary.

IIC3cs—26 to 34 inches; light gray (N 7/0) clay loam, gray (N 5/0) moist; reddish brown (2.5YR 4/4) and dark red (2.5YR 3/6) moist, rubbed; massive; hard, very friable, slightly sticky and slightly plastic; few very fine tubular pores; 10 percent soft shale fragments; slightly effervescent; moderately alkaline; abrupt wavy boundary.

IIICr—34 inches; variegated very thin-bedded shale.

A gravel pavement 1/4 to 1 inch thick is on the surface. Depth to shale ranges from 20 to 40 inches. The gypsic horizon is at a depth of 2 to 8 inches. The solum is 5 to 20 percent coarse fragments. The A1 horizon is brown or yellowish red. The C horizon is variegated pink, light gray, or yellowish red. It is sandy loam or clay loam. Gypsum content of the gypsic horizon is more than 40 percent.

Quivera series

The Quivera series consists of deep, well drained, slowly permeable soils on fan terraces. These soils formed in alluvium derived from pyroclastics. Slope ranges from 0 to 8 percent. The average annual precipitation is 12 to 14 inches, and the average annual air temperature is 49 to 54 degrees F.

These soils are fine, mixed, mesic Aridic Argiustolls.

Typical pedon of Quivera very gravelly loam, 0 to 8 percent slopes, about 19 miles north and 4 miles east of Williams; 500 feet south and 50 feet west of the east quarter corner of sec. 26, T. 25 N., R. 2 E.

A1—0 to 3 inches; brown (10YR 5/3) very gravelly loam, dark brown (7.5YR 3/2) moist; moderate fine granular; slightly hard, very friable, slightly sticky and slightly plastic; many very fine and fine roots, common very fine interstitial pores; 60 percent pebbles; neutral; clear smooth boundary.

IIB21t—3 to 8 inches; brown (10YR 4/3) gravelly clay, dark brown (7.5YR 3/2) moist; moderate very fine, fine, and medium subangular blocky structure; hard, friable, sticky and plastic; many very fine and fine roots; few very fine tubular pores, common fine and medium interstitial pores; few thin clay films on faces of peds and in pores; 15 percent pebbles; slightly effervescent; neutral; clear smooth boundary.

IIB22t—8 to 13 inches; brown (10YR 5/3) gravelly clay, dark brown (10YR 3/3) moist; moderate coarse prismatic structure parting to weak very fine subangular blocky; hard, friable, sticky and plastic; many very fine roots; few very fine tubular pores and common fine interstitial pores; few thin clay films on faces of peds and in pores; 15 percent pebbles; few fine lime filaments; slightly effervescent; moderately alkaline; clear wavy boundary.

IIB3tca—13 to 28 inches; brown (7.5YR 5/4) gravelly clay, brown (7.5YR 4/4) moist; weak very fine and fine subangular blocky structure; hard, firm, sticky and plastic; few very fine roots; few very fine tubular and interstitial pores; few thin clay films on faces of peds and in pores; 15 percent pebbles; strongly effervescent; many lime filaments; moderately alkaline; clear wavy boundary.

IIICca—28 to 60 inches; light brown (7.5YR 6/4) very gravelly loam, brown (7.5YR 5/4) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; common fine interstitial pores; 40 percent pebbles; violently effervescent; many soft lime masses; moderately alkaline.

Thickness of the solum and depth to the calcic horizon range from 20 to 40 inches. The A1 horizon is brown or dark brown. The Bt horizon is brown or reddish brown. It is gravelly clay loam or gravelly clay and is 35 to 50 percent clay. The Bt horizon is 15 to 30 percent gravel. The Cca horizon is light brown or pink. It is 35 to 50 percent coarse fragments.

Rune series

The Rune series consists of deep, well drained, slowly permeable soils on stream terraces and alluvial fans. These soils formed in stratified mixed alluvium. Slope ranges from 0 to 8 percent. The average annual precipitation is 12 to 16 inches, and the average annual air temperature is 50 to 54 degrees F.

These soils are fine, mixed, mesic Cumulic Haplustolls.

Typical pedon of Rune silty clay loam, 0 to 8 percent slopes, about 15 miles northeast of Ashfork; 1,000 feet south and 1,000 feet west of the northwest corner of sec. 10, T. 24 N., R. 1 W.

A11—0 to 3 inches; reddish brown (5YR 5/3) silty clay loam, dark reddish brown (5YR 3/3) moist; moderate fine granular structure; soft, friable, sticky and plastic; common fine roots; many fine interstitial pores; slightly effervescent; moderately alkaline; gradual smooth boundary.

A12—3 to 27 inches; reddish brown (5YR 5/3) silty clay, dark reddish brown (5YR 3/3) moist; weak medium subangular blocky structure; hard, very firm, very sticky and very plastic; few fine roots; few fine pores; strongly effervescent; moderately alkaline; diffuse wavy boundary.

C—27 to 60 inches; reddish brown (5YR 5/3) silty clay, reddish brown (5YR 4/3) moist; weak medium subangular blocky structure; hard, very firm, very sticky and very plastic; few mycelia and splotches of lime; few fine roots; few fine pores; strongly effervescent; moderately alkaline.

The profile is 60 inches thick or more. The C horizon is silty clay or clay.

Seligman series

The Seligman series consists of shallow, well drained, slowly permeable soils on broad plateaus and mesas. These soils formed in alluvium and colluvium derived from tuff and acid igneous rock. Slope ranges from 1 to 15 percent. The average annual precipitation is 14 to 18 inches, and the average annual air temperature is 50 to 54 degrees F.

These soils are clayey, montmorillonitic, mesic, shallow Aridic Argiustolls.

Typical pedon of Seligman very gravelly clay loam in an area of Boquillas-Seligman complex, 1 to 15 percent slopes, at the base of Mount Floyd; 1,500 feet east and 1,500 feet south of the northwest corner of sec. 16, T. 23 N., R. 4 W.

A1—0 to 3 inches; brown (7.5YR 5/2) very gravelly clay loam, dark brown (7.5YR 3/2) moist; moderate fine and medium granular structure; slightly hard, very friable, sticky and plastic; common very fine and fine roots; common very fine interstitial pores; 40 percent

hard pebbles; mildly alkaline; abrupt smooth boundary.

B2t—3 to 15 inches; dark reddish brown (5YR 3/2) clay, dark reddish brown (5YR 3/2) moist; strong medium and coarse prismatic structure parting to moderate fine and medium subangular blocky; very hard, very firm, sticky and very plastic; many very fine and common fine roots; few very fine interstitial and tubular pores; many pressure faces; 10 percent hard pebbles; mildly alkaline; abrupt smooth boundary.

IICr—15 inches; extremely hard pumiceous tuff; can be dug with difficulty with a spade after soaking with water.

Depth to tuff ranges from 7 to 20 inches. The B2t horizon is sandy clay, gravelly clay loam, clay, or gravelly clay and is 5 to 30 percent hard coarse fragments.

Servilleta series

The Servilleta series consists of moderately deep, well drained, slowly permeable soils on plateaus and mesas. These soils formed in alluvium derived from shale, sandstone, and quartzite. Slope ranges from 1 to 8 percent. The average annual precipitation is 12 to 14 inches, and the average annual air temperature is 49 to 54 degrees F.

These soils are fine, mixed, mesic Ustollic Haplargids.

Typical pedon of a Servilleta fine sandy loam in an area of Servilleta-Tusayan complex, 1 to 8 percent slopes, about 50 miles northwest of Flagstaff; 2,500 feet south and 500 feet east of the northwest corner of sec. 1, T. 26 N., R. 2 E.

A1—0 to 2 inches; light reddish brown (5YR 6/4) fine sandy loam, reddish brown (5YR 4/4) moist; weak medium platy structure; slightly hard, friable, nonsticky and slightly plastic; few fine roots; many very fine vesicular pores; moderately alkaline; abrupt smooth boundary.

B1t—2 to 6 inches; reddish brown (5YR 4/4) clay loam, dark reddish brown (5YR 3/4) moist; weak fine granular structure; soft, very friable, slightly sticky and plastic; common very fine and fine roots; many very fine interstitial pores; moderately alkaline; clear smooth boundary.

B21tca—6 to 11 inches; reddish brown (2.5YR 4/4) clay, dark reddish brown (2.5YR 3/4) moist; weak coarse subangular blocky structure parting to moderate very fine subangular blocky; hard, firm, sticky and plastic; common fine roots; common very fine interstitial pores and few fine tubular pores; common thin clay films on faces of peds; moderately alkaline; diffuse wavy boundary.

B22tca—11 to 17 inches; reddish brown (2.5YR 5/4) clay, reddish brown (2.5YR 4/4) moist; weak coarse subangular blocky structure parting to weak very fine subangular blocky; slightly hard, firm, slightly sticky and plastic; few very fine roots; few very fine interstitial and tubular pores; few thin clay films in pores; many medium distinct pink (5YR 7/4) carbonate segregations, light reddish brown (5YR 5/4) moist; strongly effervescent; moderately alkaline; clear wavy boundary.

IIB3ca—17 to 21 inches; pink (5YR 7/4) clay loam, light reddish brown (5YR 6/4) moist; massive; slightly hard, firm, slightly sticky and slightly plastic; few very fine roots; few very fine tubular and interstitial pores; violently effervescent; moderately alkaline; diffuse irregular boundary.

IICca—21 to 35 inches; pink (5YR 8/3) gravelly clay loam, reddish yellow (5YR 6/6) moist; massive; slightly hard, firm, slightly sticky and slightly plastic; few very fine roots; few very fine interstitial and tubular pores; 30 percent pebble-sized shale fragments; violently effervescent; moderately alkaline; abrupt wavy boundary.

IIIR—35 inches; fractured hard shale; common carbonate coatings in joints.

The solum is 12 to 24 inches thick. It is 5 to 30 percent coarse fragments and is neutral to moderately alkaline in the upper 17 inches. Shale is at a depth of 20 to 40 inches. The A1 horizon is light reddish brown or reddish brown. The B2t horizon is yellowish red, reddish brown, or red. It is clay loam or clay. The C horizon is pink or reddish yellow. It is clay loam or gravelly clay loam.

Showlow series

The Showlow series consists of deep, well drained, slowly permeable soils on fan terraces and hillsides. These soils formed in alluvium derived from sandstone, shale, quartzite, and limestone. Slope ranges from 0 to 30 percent. The average annual precipitation is 12 to 16 inches, and the average annual air temperature is 50 to 54 degrees F.

These soils are fine, montmorillonitic, mesic Aridic Argiustolls.

Typical pedon of Showlow gravelly fine sandy loam, 8 to 30 percent slopes, about 12 miles north of Ashfork; 1,600 feet east and 660 feet north of the west quarter corner of sec. 33, T. 24 N., R. 2 W.

A1—0 to 2 inches; dark brown (7.5YR 4/2) gravelly fine sandy loam, dark brown (7.5YR 3/2) moist; weak medium platy structure parting to moderate fine granular; soft, friable, nonsticky and nonplastic; few medium roots; many fine interstitial pores; 20 percent pebbles; neutral; abrupt smooth boundary.

B1t—2 to 10 inches; reddish brown (5YR 5/3) gravelly clay loam, dark reddish brown (5YR 3/3) moist; moderate medium subangular blocky structure; hard, firm, sticky and very plastic; common thin clay films on faces of peds; common fine and medium roots;

common fine and medium pores; 20 percent pebbles; neutral; clear wavy boundary.

B21t—10 to 16 inches; reddish brown (5YR 4/4) gravelly clay, dark reddish brown (5YR 3/4) moist; weak fine and medium angular blocky structure; very hard, firm, sticky and very plastic; thin continuous clay films on faces of peds; common fine and medium roots; few fine tubular pores; 20 percent pebbles; neutral; clear wavy boundary.

B22t—16 to 27 inches; red (2.5YR) gravelly clay, dark red (2.5YR 3/6) moist; moderate medium angular blocky structure; very hard, firm, sticky and plastic; few fine and medium roots; few fine tubular pores; thin continuous clay films on faces of peds; 20 percent pebbles; mildly alkaline; clear wavy boundary.

B3t—27 to 30 inches; yellowish red (5YR 5/8) gravelly sandy clay loam, yellowish red (5YR 4/8) moist; massive; very hard, firm, slightly sticky and slightly plastic; few thin manganese coatings on faces of peds; few fine and medium roots; few interstitial pores; 25 percent pebbles; slightly effervescent; mildly alkaline; clear wavy boundary.

Cca—30 to 60 inches; reddish yellow (7.5YR 7/6) very gravelly clay loam, brown (7.5YR 4/4) moist; massive; extremely hard, firm, slightly sticky and slightly plastic; splotches of lime; few interstitial pores; 50 percent pebbles; strongly effervescent; moderately alkaline.

The solum is 20 to 40 inches thick. It is 10 to 35 percent coarse fragments and is neutral to moderately alkaline. The A1 horizon is dark brown or brown. The B2t horizon is red to reddish brown. It is clay or gravelly clay. The C horizon is gravelly sandy clay loam, gravelly clay loam, or very gravelly clay loam.

Springerville series

The Springerville series consists of deep, well drained, very slowly permeable soils on fan terraces and in basins. These soils formed in alluvium and colluvium derived from basalt and pyroclastics. Slope ranges from 0 to 15 percent. The average annual precipitation is 12 to 16 inches, and the average annual air temperature is 50 to 54 degrees F.

These soils are fine, montmorillonitic, mesic Udic Chromusterts.

Typical pedon of Springerville cobbly clay, 0 to 8 percent slopes, about 15 miles east of Ashfork and 4.5 miles south of Mount Floyd; 1,500 feet south and 300 feet east of the northwest corner of sec. 3, T. 22 N., R. 4 W.

A11—0 to 3 inches; brown (7.5YR 4/2) cobbly clay, dark brown (7.5YR 3/2) moist; strong fine granular structure; slightly hard, friable, sticky and plastic; few very fine roots; many very fine interstitial pores; 30 percent cobbles; moderately alkaline; clear smooth boundary.

A12—3 to 12 inches; dark reddish brown (5YR 3/4) clay, dark reddish brown (5YR 3/2) moist; moderate fine and medium subangular blocky structure; hard, firm, very sticky and very plastic; few very fine, fine, and medium roots; common very fine tubular pores; moderately alkaline; clear smooth boundary.

C1—12 to 28 inches; dark reddish brown (5YR 3/4) clay, dark reddish brown (5YR 3/2) moist; moderate fine and medium subangular blocky structure; very hard, very firm, very sticky and very plastic; common very fine and few medium roots; common very fine tubular pores; few slickensides tilted 20 to 40 degrees from horizontal; many cracks 1/4 to 1 inch wide throughout horizon; moderately alkaline; clear smooth boundary.

C2—28 to 42 inches; dark reddish brown (5YR 3/4) clay, dark reddish brown (5YR 3/2) moist; massive; very hard, very firm, very sticky and very plastic; few very fine, fine, and medium roots; common very fine tubular pores; common slickensides tilted 20 to 40 degrees from horizontal; many cracks 1/4 to 1 inch wide extend to bedrock; moderately alkaline; abrupt smooth boundary.

IIR—42 inches; fractured basalt; common calcium carbonates in joints.

About 5 to 30 percent of the surface is covered with coarse fragments of basalt. Bedrock is at a depth of 40 to 60 inches. The profile is mildly alkaline or moderately alkaline throughout. The A horizon is light brown, reddish brown, or dark reddish brown. It is cobbly clay or very stony clay. The C horizon is brown, reddish brown, or dark reddish brown. It is mainly clay, but it is silty clay in places.

Tajo series

The Tajo series consists of moderately deep, well drained, moderately slowly permeable soils on fan terraces. These soils formed in alluvium and colluvium derived from pyroclastics and basalt. Slope ranges from 0 to 15 percent. The average annual precipitation is 12 to 16 inches, and the average annual air temperature is 50 to 54 degrees F.

These soils are fine-loamy, mixed, mesic Petrocalcic Paleustolls.

Typical pedon of a Tajo gravelly loam in an area of Tajo-Springerville complex, 0 to 15 percent slopes, about 5 miles west of Ashfork; 1,000 feet west and 1,400 feet north of the southeast corner of sec. 35, T. 22 N., R. 3 W.

A1—0 to 3 inches; brown (7.5YR 5/2) gravelly loam, dark brown (7.5YR 3/2) moist; weak thin platy structure parting to moderate fine granular; slightly hard, very friable, slightly sticky and slightly plastic;

common very fine and fine roots; few very fine and fine interstitial pores; 30 percent fine angular hardened lime fragments; violently effervescent; moderately alkaline; clear smooth boundary.

B21—3 to 11 inches; brown (7.5YR 5/2) clay loam, dark brown (7.5YR 3/2) moist; moderate fine and medium subangular blocky structure; slightly hard, very friable, sticky and plastic; common very fine roots; common very fine and fine tubular pores; few very fine and fine lime threads; 10 percent fine angular hardened lime fragments; violently effervescent; moderately alkaline; clear smooth boundary.

B22t—11 to 18 inches; brown (10YR 4/3) clay loam, dark brown (7.5YR 3/4) moist; moderate fine and medium subangular blocky structure; slightly hard, very friable, sticky and plastic; few to common very fine roots; common very fine and fine tubular pores; very few thin clay films lining pores; few very fine and fine lime threads; 5 percent lime-coated basalt cobbles and 5 percent pebbles; violently effervescent; moderately alkaline; clear smooth boundary.

C1ca—18 to 24 inches; brown (10YR 5/3) gravelly clay loam, dark brown (7.5YR 3/4) moist; massive; slightly hard, very friable, sticky and plastic; few to common very fine roots; common very fine and fine tubular pores; few very fine and fine lime threads; 20 percent lime-coated basalt pebbles and 10 percent pebble-sized pan fragments; violently effervescent; moderately alkaline; abrupt wavy boundary.

IIC2cam—24 to 30 inches; white (10YR 8/2) indurated lime-cemented hardpan, very pale brown (10YR 7/3) moist; massive; extremely hard; violently effervescent; moderately alkaline; clear wavy boundary.

IIC3ca—30 to 50 inches; white (10YR 8/1) very cobbly sandy loam, very pale brown (10YR 7/3) moist; massive; hard, friable, slightly sticky and nonplastic; thin discontinuous weakly to strongly cemented horizons; violently effervescent; moderately alkaline; 40 percent cobbles; abrupt wavy boundary.

IIIR—50 inches; fractured basalt; common calcium carbonates in joints.

The solum is 20 to 34 inches thick. The petrocalcic horizon is at a depth of 20 to 40 inches. The R horizon is at a depth of 40 to 60 inches. The A and Bt horizons are brown or dark brown. The Bt is clay loam or gravelly clay loam.

Tenorio series

The Tenorio series consists of deep, well drained, moderately slowly permeable soils on stream terraces. These soils formed in mixed alluvium. Slope ranges from 0 to 8 percent. The average annual precipitation is 12 to 14 inches, and the average annual air temperature is 50 to 54 degrees F.

These soils are fine-loamy over sandy or sandy-skeletal, mixed, mesic Ustollic Haplargids.

Typical pedon of Tenorio very gravelly sandy loam, 0 to 8 percent slopes, about 36 miles north-northeast of Williams; 1,500 feet south and 2,000 feet east of the northwest corner of sec. 33, T. 27 N., R. 2 W.

A1—0 to 3 inches; brown (10YR 5/3) very gravelly sandy loam, dark brown (7.5YR 3/4) moist; moderate fine granular structure; soft, very friable, nonsticky and nonplastic; common fine roots; many very fine interstitial pores; 50 percent of the surface is covered with pebbles less than 3/8 inch in diameter and 30 percent is covered with pebbles more than 3/8 inch in diameter; slightly acid; clear smooth boundary.

B21t—3 to 8 inches; brown (7.5YR 4/3) gravelly clay loam, dark brown (7.5YR 3/4) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; common fine tubular and interstitial pores; common thin clay films as bridges in pores and on faces of peds; 5 percent pebbles more than 3/8 inch in diameter and 15 percent less than 3/8 inch in diameter; neutral; gradual wavy boundary.

B22t—8 to 16 inches; reddish brown (5YR 4/4) gravelly clay loam, reddish brown (5YR 4/3) moist; moderate medium subangular blocky structure; hard, friable, sticky and plastic; many very fine and fine roots; common thin clay films on faces of peds and in pores; 30 to 35 percent pebbles less than 3/8 inch in diameter; neutral; gradual wavy boundary.

B3t—16 to 23 inches; yellowish red (5YR 5/6) very gravelly loamy sand, yellowish red (5YR 4/6) moist; massive; slightly hard, friable, slightly sticky and nonplastic; many very fine roots; common very fine interstitial pores; few thin clay films as bridges and as coatings on pebbles; 25 percent pebbles more than 3/8 inch in diameter and 25 percent less than 3/8 inch in diameter; very slightly effervescent; moderately alkaline; clear wavy boundary.

IIC1—23 to 33 inches; yellowish red (5YR 5/6) extremely gravelly sand, yellowish red (5YR 4/6) moist; single grain; loose; few medium and coarse roots; many interstitial pores; many thin strata of sand, gravelly sand, and very gravelly sand; 20 percent pebbles more than 3/8 inch in diameter and 45 percent less than 3/8 inch in diameter; very slightly effervescent; moderately alkaline; gradual wavy boundary.

IIC2—33 to 60 inches; yellowish red (5YR 5/6) extremely gravelly sand, yellowish red (5YR 4/6) moist; single grain; loose; few medium and coarse roots; strata of sand and coarse sand 1/2 inch to 5 inches thick; 40 percent pebbles more than 3/8 inch in diameter and 45 percent less than 3/8 inch in diameter; moderately alkaline.

Thickness of the solum and depth to the IIC horizon range from 20 to 30 inches. The solum is 20 to 35 percent coarse fragments. The A1 horizon is dark brown or brown. It is slightly acid to mildly alkaline. The B2t horizon is reddish brown, yellowish red, brown, or dark brown. It is gravelly clay loam or gravelly loam. The B3t horizon is gravelly clay loam, very gravelly sandy clay loam, or very gravelly loamy sand. The IIC horizon is 60 to 80 percent gravel. The Bt and IIC horizons are mildly alkaline or moderately alkaline.

Thunderbird series

The Thunderbird series consists of moderately deep, well drained, slowly permeable soils on hillsides. These soils formed in alluvium and colluvium derived from basalt and pyroclastics. Slope ranges from 1 to 60 percent. The average annual precipitation is 12 to 16 inches, and the average annual air temperature is 50 to 54 degrees F.

These soils are fine, montmorillonitic, mesic Aridic Argiustolls.

Typical pedon of a Thunderbird very stony clay loam in an area of Thunderbird-Springerville association, strongly sloping, about 11 miles east of Seligman, near Santa Fe Railroad; 500 feet south of the northwest corner of sec. 1, T. 22 N., R. 4 W.

A1—0 to 2 inches; grayish brown (10YR 5/2) very stony clay loam, very dark brown (10YR 3/2) moist; strong fine granular structure; slightly hard, friable, sticky and plastic; few fine roots; many fine interstitial pores; 35 percent stones and 20 percent pebbles; mildly alkaline; abrupt wavy boundary.

B1t—2 to 6 inches; dark brown (7.5YR 4/2) clay loam, dark brown (7.5YR 3/2) moist; moderate fine and medium subangular and angular blocky structure; hard, firm, sticky and plastic; few thin clay films on faces of peds; many fine and medium roots; common fine and medium tubular pores; 10 percent cobbles and pebbles; moderately alkaline; clear wavy boundary.

B21t—6 to 19 inches; dark brown (7.5YR 4/2) clay, dark brown (7.5YR 3/2) moist; strong fine and medium subangular and angular blocky structure; extremely hard, very firm, very sticky and very plastic; thin continuous clay films on faces of peds; common fine medium and coarse roots; few fine and medium tubular pores; 10 percent cobbles and pebbles; moderately alkaline; clear wavy boundary.

B22t—19 to 24 inches; brown (7.5YR 5/4) clay, dark brown (7.5YR 4/4) moist; strong fine and medium subangular and angular blocky structure; extremely hard, very firm, very sticky and very plastic; thin continuous clay films on faces of peds; few soft lime masses; common fine, medium, and coarse roots; few fine and medium tubular pores; 10 percent cobbles and pebbles; slightly effervescent; moderately alkaline; abrupt irregular boundary.

IIR—24 inches; vesicular basalt with few small calcite phenocrysts.

Thickness of the solum and depth to bedrock range from 20 to 40 inches. The A1 horizon is grayish brown or brown. It is very cobbly clay loam, very stony clay loam, or extremely stony clay loam. The B2t horizon is dark brown or brown. It is clay loam or clay.

Toqui series

The Toqui series consists of very shallow and shallow, well drained, slowly permeable soils on plateaus and mesas. These soils formed in alluvial and eolian deposits derived from limestone and calcareous sandstone. Slope ranges from 0 to 8 percent. The average annual precipitation is 14 to 16 inches, and the average annual air temperature is 49 to 52 degrees F.

These soils are clayey, mixed, mesic Lithic Haplustalfs.

Typical pedon of Toqui fine sandy loam in an area of Deama-Toqui complex, 0 to 8 percent slopes, about 10 miles southwest of the Grand Canyon Village; 1,000 feet east and 1,000 feet south of the northwest corner of sec. 16, T. 30 N., R. 1 E.

A1—0 to 1 inch; brown (7.5YR 5/4) fine sandy loam, dark brown (7.5YR 4/4) moist; weak fine granular structure; soft, very friable, nonsticky and nonplastic; many very fine tubular pores; many fine roots; 5 percent fine pebbles; slightly acid; abrupt smooth boundary.

A2—1 to 3 inches; light yellowish brown (10YR 6/4) very fine sandy loam, dark yellowish brown (10YR 4/4) moist; weak thin platy structure; soft, very friable, nonsticky and nonplastic; few fine roots; many very fine vesicular pores; slightly acid; abrupt smooth boundary.

B1t—3 to 5 inches; reddish brown (5YR 4/4) clay loam, dark reddish brown (5YR 3/4) moist; weak fine subangular blocky structure; slightly hard, friable, sticky and plastic; common very fine and fine roots; many very fine and few fine tubular pores; few thin clay films on faces of peds; 5 percent pebbles; neutral; clear smooth boundary.

B2t—5 to 12 inches; reddish brown (5YR 4/4) clay, dark reddish brown (5YR 3/4) moist; common fine and medium subangular blocky structure; very hard, firm, very sticky and very plastic; common very fine and few coarse roots; common very fine tubular pores; many moderately thick clay films on faces of peds; 5 percent pebbles; moderately alkaline; gradual smooth boundary.

B3ca—12 to 15 inches; reddish brown (5YR 5/4) clay loam, dark reddish brown (5YR 3/4) moist; weak fine subangular blocky structure; hard, firm, sticky and plastic; common very fine and few fine roots; common very fine tubular pores; 10 percent pebbles; moderately alkaline; clear smooth boundary.

Cca—15 to 19 inches; reddish brown (5YR 5/4) very gravelly clay loam, reddish brown (5YR 4/4) moist; massive; hard, firm, sticky and plastic; common very fine and fine roots; few fine pores; 45 percent limestone pebbles; strongly effervescent; moderately alkaline; abrupt smooth boundary.

IIR—19 inches; white fractured limestone; many pendants on fragments.

Bedrock is at a depth of 8 to 20 inches. The profile is 5 to 30 percent coarse fragments. The A1 horizon is brown or reddish brown. The A2 horizon is pale brown or light yellowish brown very fine sandy loam, fine sandy loam, or sandy loam. The A1 and A2 horizons are slightly acid or neutral. The B horizon is reddish brown or yellowish red gravelly clay loam, clay loam, gravelly clay, or clay. The Cca horizon is reddish brown or pinkish white. It is very gravelly clay loam, gravelly clay loam, or gravelly loam. Above the limestone in some pedons is a discontinuous horizon that is cemented with calcium carbonate and is 1 to 2 centimeters thick.

Tours series

The Tours series consists of deep, well drained, moderately slowly permeable soils on flood plains and alluvial fans. These soils formed in mixed alluvium. Slope ranges from 0 to 8 percent. The average annual precipitation is 6 to 10 inches, and the average annual air temperature is 52 to 55 degrees F.

These soils are fine-silty, mixed (calcareous), mesic Typic Torrifluvents.

Typical pedon of a Tours fine sandy loam in an area of Tours-Ives association, gently sloping, about 5 miles west of Navajo County line and 2.5 miles south of Interstate 40; 800 feet east of the northwest corner of sec. 1, T. 19 N., R. 15 E.

A1—0 to 2 inches; light reddish brown (2.5YR 6/4) fine sandy loam, reddish brown (2.5YR 4/4) moist; moderate fine platy structure; hard, firm, sticky and plastic; few medium roots; many very fine vesicular pores; strongly effervescent; moderately alkaline; clear smooth boundary.

C1—2 to 10 inches; reddish brown (2.5YR 5/4) sandy clay loam, reddish brown (2.5YR 4/4) moist; weak thick platy structure parting to weak fine subangular blocky; hard, friable, slightly sticky and slightly plastic; common fine roots; many very fine vesicular pores and few fine tubular pores; strongly effervescent; moderately alkaline; abrupt smooth boundary.

C2—10 to 24 inches; reddish brown (2.5YR 5/4) silty clay loam, reddish brown (2.5YR 3/4) moist; moderate fine platy structure; hard, firm, sticky and plastic; common very fine and fine roots; few fine tubular pores; strongly effervescent; moderately alkaline; clear smooth boundary.

C3—24 to 39 inches; reddish brown (2.5YR 5/4) silt loam, dark red (2.5YR 3/6) moist; weak fine platy structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; few fine tubular pores; strongly effervescent; moderately alkaline; clear smooth boundary.

C4—39 to 46 inches; reddish brown (2.5YR 5/4) very fine sandy loam, dark red (2.5YR 3/6) moist; weak coarse platy structure parting to weak fine subangular blocky; hard, firm, sticky and plastic; few very fine roots; common fine tubular pores; strongly effervescent; moderately alkaline; abrupt smooth boundary.

C5—46 to 60 inches; reddish brown (2.5YR 5/4) silty clay loam, reddish brown (2.5YR 3/4) moist; moderate fine platy structure; hard, firm, sticky and plastic; few very fine roots; common fine tubular pores; strongly effervescent; moderately alkaline.

The profile is 60 inches or more in thickness. It is slightly calcareous to strongly calcareous. The lime commonly is well disseminated, but some of it consists of small soft masses or filaments. The profile is mildly alkaline or moderately alkaline throughout. It is 0 to 5 percent coarse fragments. The A horizon is light reddish brown or reddish brown. The C horizon is yellowish red or reddish brown. It is very fine sandy loam, silt loam, clay loam, sandy clay loam, or silty clay loam.

Tovar series

The Tovar series consists of moderately deep, well drained, slowly permeable soils on hillsides. These soils formed in alluvium and colluvium derived from sandstone. Slope ranges from 2 to 60 percent. The average annual precipitation is 14 to 16 inches, and the average annual air temperature is 50 to 54 degrees F.

These soils are fine, mixed, mesic Aridic Haplustalfs.

Typical pedon of a Tovar fine sandy loam in an area of Tovar complex, 2 to 25 percent slopes (fig. 3), about 10 miles north of Ashfork and 500 feet south of Santa Fe Railroad; 800 feet north and 600 feet west of the center of sec. 13, T. 23 N., R. 3 W.

A1—0 to 3 inches; reddish brown (7.5YR 5/4) fine sandy loam, reddish brown (5YR 4/3) moist; weak thick platy structure parting to moderate fine granular; soft, very friable, nonsticky and nonplastic; few very fine and fine roots; common very fine and fine vesicular pores; 10 percent channery fragments; neutral; clear smooth boundary.

B1t—3 to 8 inches; brown (7.5YR 4/4) flaggy sandy clay loam, dark reddish brown (5YR 3/4) moist; weak fine subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common fine roots; common fine discontinuous irregular pores; few thin clay films on faces of peds; 20 percent flagstones and 10 percent channery fragments; neutral; clear smooth boundary.

Figure 3.—Profile of a Tovar fine sandy loam in an area of Tovar complex, 2 to 25 percent slopes.

IIB21t—8 to 16 inches; dark reddish brown (5YR 3/4) flaggy clay, dark reddish brown (5YR 3/4) moist; strong medium and coarse prismatic structure; very hard, very firm, sticky and very plastic; common very fine roots; few very fine discontinuous irregular pores; 20 percent flagstones and 10 percent channery fragments; continuous moderately thick clay films on faces of peds; mildly alkaline; clear smooth boundary.

IIB22t—16 to 25 inches; reddish brown (5YR 4/4) flaggy clay, reddish brown (5YR 4/4) moist; strong medium subangular blocky structure; very hard, very firm, sticky and very plastic; common very fine roots; few very fine discontinuous irregular pores; 20 percent flagstones and 10 percent channery fragments; continuous moderately thick clay films on faces of peds; mildly alkaline; gradual smooth boundary.

IIB23t—25 to 35 inches; yellowish red (5YR 4/6) flaggy clay, reddish brown (5YR 4/4) moist; moderate fine and medium subangular blocky structure; very hard, very firm, sticky and plastic; few very fine roots; few very fine discontinuous irregular pores; 30 percent flagstones; many moderately thick clay films on faces of peds; mildly alkaline; abrupt smooth boundary.

IIIR—35 inches; thin-bedded hard sandstone; few thin coatings of lime in fractures.

Thickness of the solum and depth to bedrock range from 20 to 40 inches. The solum is 20 to 35 percent coarse fragments. The A1 horizon is brown or reddish brown. It is fine sandy loam, stony loam, very stony fine sandy loam, or extremely stony fine sandy loam. It is slightly acid to mildly alkaline. The Bt horizon is brown, dark reddish brown, reddish brown, or yellowish red. It is neutral to moderately alkaline.

Tusayan series

The Tusayan series consists of moderately deep, well drained, moderately permeable soils on plateaus and mesas. These soils formed in alluvial and eolian deposits derived from limestone and calcareous sandstone. Slope ranges from 0 to 8 percent. The average annual precipitation is 10 to 14 inches, and the average annual air temperature is 50 to 54 degrees F.

These soils are loamy-skeletal, carbonatic, mesic Ustollic Calciorthids.

Typical pedon of Tusayan gravelly sandy loam in an area of Winona-Tusayan association, gently sloping, about 7.1 miles south of Meteor Crater; 3,000 feet east and 1,000 feet north of the southwest corner of sec. 14, T. 18 N., R. 12 E.

A11—0 to 3 inches; brown (7.5YR 5/4) gravelly sandy loam, dark brown (7.5YR 4/4) moist; weak very fine granular structure; soft, very friable, nonsticky and nonplastic; many very fine and fine roots; 30 percent pebbles; violently effervescent; moderately alkaline; clear smooth boundary.

A12—3 to 10 inches; brown (10YR 5/3) gravelly loam, dark yellowish brown (10YR 3/4) moist; weak fine

subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine and fine roots; common very fine tubular pores; violently effervescent; moderately alkaline; clear smooth boundary.

B2—10 to 16 inches; light brownish gray (10YR 6/2) very gravelly loam, brown (7.5YR 4/4) moist; weak fine and medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine roots; common very fine tubular pores; 40 percent lime-coated gravel; violently effervescent; moderately alkaline; clear smooth boundary.

B3ca—16 to 27 inches; brown (10YR 5/3) extremely gravelly loam, dark brown (7.5YR 4/4) moist; weak very fine subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine roots; common very fine tubular pores; 70 percent fine and medium lime concretions and calcareous sandstone fragments; violently effervescent; moderately alkaline; clear smooth boundary.

Cca—27 to 29 inches; light brown (7.5YR 6/4) very gravelly loam, strong brown (7.5YR 5/6) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; 60 percent fine and medium lime concretions and calcareous sandstone fragments; violently effervescent; moderately alkaline; abrupt smooth boundary.

IIR—29 inches; fractured calcareous sandstone; discontinuous cemented layer 1 to 2 centimeters thick; many lime pendants on underside of fragments.

Bedrock is at a depth of 20 to 40 inches. The profile is 20 to 80 percent coarse fragments but averages more than 35 percent. It is more than 40 percent calcium carbonate. The A horizon is brown, grayish brown, or yellowish brown. It is gravelly loam or gravelly sandy loam. The B horizon is brown, dark brown, or light brownish gray. It is gravelly loam, very gravelly loam, or extremely gravelly loam. The Cca horizon is lignt brown or reddish brown.

Tuweep series

The Tuweep series consists of deep, well drained, moderately slowly permeable soils on plateaus and mesas. These soils formed in alluvium derived from basalt and pyroclastics. Slope ranges from 0 to 15 percent. The average annual precipitation is 8 to 14 inches, and the average annual air temperature is 52 to 55 degrees F.

These soils are fine-loamy, mixed, mesic Ustollic Haplargids.

Typical pedon of Tuweep very gravelly loam, 0 to 15 percent slopes, about 25 miles northeast of Flagstaff; 2,500 feet west and 2,000 feet south of the northeast corner of sec. 3, T. 26 N., R. 8 E.

A11—0 to 3 inches; pale brown (10YR 6/3) very gravelly loam, brown (10YR 4/3) moist; moderate thick platy structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine and medium roots; many very fine and fine vesicular pores; 55 percent pebbles; slightly effervescent; moderately alkaline; clear smooth boundary.

B21t—3 to 9 inches; pale brown (10YR 6/3) clay loam, dark brown (10YR 3/3) moist; moderate fine subangular blocky structure; hard, very friable, slightly sticky and slightly plastic; common fine and medium roots; common fine tubular and interstitial pores; few thin clay films in pores; 10 percent pebbles; slightly effervescent; mildly alkaline; clear wavy boundary.

B22tca—9 to 16 inches; light yellowish brown (10YR 6/4) clay loam, brown (7.5YR 5/4) moist; weak very fine and fine subangular blocky structure; slightly hard, very friable, sticky and slightly plastic; common fine and medium roots; common fine tubular and interstitial pores; few moderately thick clay films in tubular pores; strongly effervescent; moderately alkaline; clear wavy boundary.

C1ca—16 to 34 inches; very pale brown (10YR 8/3) clay loam, light brown (7.5YR 6/4) moist; massive; slightly hard, very friable, sticky and plastic; common fine and medium roots; few very fine and fine tubular pores; common soft lime masses; 45 percent calcium carbonate; violently effervescent; moderately alkaline; abrupt irregular boundary.

IIC2ca—34 to 60 inches; light yellowish brown (10YR 6/4) extremely stony loam, brown (7.5YR 5/4) moist; massive; soft, very friable, slightly sticky and nonplastic; few fine and medium roots; few fine interstitial pores; 70 percent lime-coated basalt stones; violently effervescent; moderately alkaline.

Thickness of the solum and depth to the calcic horizon range from 10 to 20 inches. The Bt horizon is 10 to 35 percent coarse fragments. The A1 horizon is pale brown or brown. The Bt horizon is pale brown or light yellowish brown. The Cca horizon is very pale brown or light yellowish brown. It is clay loam or very stony loam. The Cca horizon is 15 to 60 percent soft, powdery calcium carbonate.

Valle series

The Valle series consists of deep, well drained, moderately permeable soils on alluvial fans and stream terraces. These soils formed in alluvium derived from basalt and pyroclastics. Slope ranges from 0 to 8 percent. The average annual precipitation is 12 to 16 inches, and the average annual air temperature is 49 to 52 degrees F.

These soils are fine-loamy, mixed, mesic Aridic Haplustolls.

Typical pedon of Valle gravelly silt loam, 0 to 8 percent slopes, about 3 miles east and 6 miles north of

Williams; 1,500 feet east and 1,000 feet north of the southwest corner of sec. 23, T. 23 N., R. 2 E.

A11—0 to 3 inches; brown (7.5YR 5/2) gravelly silt loam, dark brown (7.5YR 3/2) moist; weak thin platy structure parting to weak fine granular; soft, friable, nonsticky and nonplastic; few fine roots; many very fine vesicular pores and common very fine interstitial pores; 20 percent pebbles; medium acid; abrupt smooth boundary.

A12—3 to 8 inches; brown (7.5YR 4/2) gravelly loam, dark brown (7.5YR 3/2) moist; weak medium subangular blocky structure parting to weak fine granular; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; common very fine interstitial pores and few very fine tubular pores; 20 percent pebbles; neutral; gradual wavy boundary.

A13—8 to 13 inches; brown (7.5YR 4/2) gravelly loam, dark brown (7.5YR 3/2) moist; weak medium subangular blocky structure parting to weak fine granular; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; common fine tubular pores; 20 percent pebbles; neutral; abrupt wavy boundary.

C1—13 to 28 inches; reddish brown (5YR 5/4) gravelly loam, reddish brown (5YR 4/4) moist; weak coarse subangular blocky structure; hard, firm, slightly sticky and slightly plastic; few very fine roots; common fine tubular pores; 20 percent pebbles; mildly alkaline; diffuse wavy boundary.

IIC2—28 to 60 inches; reddish brown (5YR 5/4) very gravelly clay loam, reddish brown (5YR 4/4) moist; massive; hard, firm, slightly sticky and nonplastic; few fine roots; few fine tubular pores; 50 percent pebbles; mildly alkaline.

The profile is 60 inches or more in thickness. It is 15 to 35 percent gravel. The A1 horizon is brown, grayish brown, or dark grayish brown. It is medium acid or neutral. The C horizon is light brown, brown, or reddish brown. It is gravelly loam to very gravelly clay loam and is neutral or mildly alkaline.

Wilaha series

The Wilaha series consists of deep, well drained, moderately slowly permeable soils on fan terraces and hillsides. These soils formed in alluvium derived from basalt and pyroclastics. Slope ranges from 0 to 60 percent. The average annual precipitation is 12 to 18 inches, and the average annual air temperature is 49 to 54 degrees F.

These soils are fine-loamy over fragmental, mixed, mesic Aridic Argiustolls.

Typical pedon of Wilaha cindery loam, 2 to 30 percent slopes, about 54 miles southeast of Flagstaff; at the south quarter corner of sec. 5, T. 16 N., R. 14 E.

A11—0 to 2 inches; reddish brown (5YR 5/3) cindery loam, dark reddish brown (5YR 3/3) moist; moderate very fine granular structure; soft, very friable, nonsticky and nonplastic; few fine roots; many interstitial pores; 20 percent cinders; mildly alkaline; abrupt smooth boundary.

A12—2 to 5 inches; reddish brown (5YR 4/3) cindery loam, dark reddish brown (5YR 3/3) moist; weak medium subangular blocky structure parting to weak fine granular; slightly hard, friable, slightly sticky and nonplastic; common fine roots; common interstitial pores and few very fine tubular pores; 25 percent cinders; mildly alkaline; gradual wavy boundary.

B21t—5 to 8 inches; reddish brown (5YR 5/3) cindery clay loam, dark reddish brown (5YR 3/3) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; common fine tubular pores; very few thin clay films lining tubular pores; 25 percent cinders; mildly alkaline; gradual wavy boundary.

B22t—8 to 14 inches; reddish brown (5YR 5/4) cindery clay loam, dark reddish brown (5YR 3/4) moist; weak medium subangular blocky structure; hard, firm, sticky and plastic; common very fine roots; few fine tubular pores; few moderately thick clay films on faces of peds; 25 percent cinders; strongly effervescent; moderately alkaline; gradual wavy boundary.

B3ca—14 to 17 inches; pinkish gray (7.5YR 7/2) very cindery loam, brown (7.5YR 5/4) moist; massive; few very fine roots; 45 percent cinders; strongly effervescent; moderately alkaline; abrupt wavy boundary.

IIC—17 to 60 inches; cinders; massive; few coarse roots; few filaments and soft masses of lime and coatings of lime on cinders in upper part.

Depth to cinders ranges from 10 to 24 inches but averages 15 to 20 inches. The profile is mildly alkaline or moderately alkaline. The A1 horizon is brown, dark brown, or reddish brown. The B2t horizon is dark reddish brown or reddish brown. It is cindery clay loam or clay loam. Cinders on the surface and in the IIC horizon are red or black.

Winona series

The Winona series consists of very shallow and shallow, well drained, moderately permeable soils on plateaus, mesas, and hillsides. These soils formed in eolian deposits underlain by alluvium derived from limestone and calcareous sandstone. Slope ranges from 0 to 70 percent. The average annual precipitation is 8 to 14 inches, and the average annual air temperature is 50 to 54 degrees F.

These soils are loamy-skeletal, mixed, mesic Lithic Ustollic Calciorthids.

Typical pedon of a Winona gravelly loam, in an area of Winona-Boysag gravelly loams, 0 to 8 percent slopes

(fig. 4), about 31 miles north of Williams; 1,800 feet south and 500 feet east of the northwest corner of sec. 35, T. 29 N., R. 1 E.

Figure 4.—Profile of a Winona gravelly loam in an area of Winona-Boysag gravelly loams, 0 to 8 percent slopes. Note the roots penetrating into the fractures in the upper part of the limestone.

A1—0 to 2 inches; brown (7.5YR 5/4) gravelly loam, dark brown (7.5YR 4/4) moist; weak fine subangular blocky structure; soft, friable, slightly sticky and slightly plastic; few fine roots; many fine interstitial pores; 25 percent pebbles and 5 percent cobbles; strongly effervescent; moderately alkaline; abrupt smooth boundary.

C1ca—2 to 12 inches; brown (10YR 5/4) extremely cobbly loam, dark brown (7.5YR 4/4) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; few fine and medium tubular pores and many fine interstitial pores; 40 percent cobbles and 25 percent limestone pebbles; violently effervescent; moderately alkaline; abrupt wavy boundary.

C2ca—12 to 15 inches; light yellowish brown (10YR 6/4) extremely cobbly loam, dark yellowish brown (10YR 4/4) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; many very fine interstitial pores and few fine tubular pores; 45 percent cobbles and 30 percent pebbles; violently effervescent; moderately alkaline; abrupt wavy boundary.

IIR—15 inches; fractured limestone; many lime pendants on fragments.

Bedrock is at a depth of 6 to 20 inches. The profile is 35 to 75 percent coarse fragments. It is mildly alkaline or moderately alkaline. The A1 horizon is brown or dark brown. It is gravelly sandy loam, gravelly loam, stony loam, or stony sandy loam. The C horizon is brown, yellowish brown, or light yellowish brown. It is very gravelly loam or extremely cobbly loam.

Wukoki series

The Wukoki series consists of deep, well drained, moderately permeable soils on fan terraces and hillsides. These soils formed in pyroclastics. Slope ranges from 0 to 60 percent. The average annual precipitation is 8 to 14 inches, and the average annual air temperature is 52 to 55 degrees F.

These soils are cindery, mesic Aridic Haplustolls.

Typical pedon of Wukoki very cindery loam in an area of Wupatki-Wukoki very cindery loams, 0 to 15 percent slopes, about 28 miles north of Flagstaff on the CO-Bar ranch; 2,000 feet east and 250 feet south of the northwest corner of sec. 36, T. 26 N., R. 7 E.

A11—0 to 2 inches; brown (10YR 5/3) very cindery loam, dark brown (7.5YR 3/2) moist; weak thick platy structure; slightly hard, very friable, slightly sticky and slightly plastic; few fine roots; many very fine and fine vesicular pores; 60 percent cinders; mildly alkaline; clear smooth boundary.

A12—2 to 10 inches; brown (10YR 5/3) very cindery loam, dark brown (7.5YR 3/2) moist; weak fine

granular and subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine and fine roots; few very fine and fine tubular pores and common very fine interstitial pores; 40 percent cinders; mildly alkaline; clear wavy boundary.

B21ca—10 to 15 inches; pale brown (10YR 6/3) very cindery loam, dark yellowish brown (10YR 3/4) moist; weak very fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine and fine roots; few very fine and fine tubular pores and common very fine interstitial pores; 50 percent cinders; strongly effervescent; moderately alkaline; clear wavy boundary.

B22ca—15 to 18 inches; light yellowish brown (10YR 6/4) very cindery loam, dark yellowish brown (10YR 3/4) moist; weak very fine granular structure; soft, very friable, slightly sticky and slightly plastic; common very fine and fine roots; common very fine interstitial pores; 55 to 60 percent cinders; violently effervescent; moderately alkaline; clear wavy boundary.

IIC—18 to 60 inches; dark gray (10YR 4/1) cinders, black (10YR 2/1) moist; single grain; cinders in upper 15 to 20 inches have coatings of lime, which decrease with depth; violently effervescent; moderately alkaline.

About 80 to 90 percent of the surface is covered with cinder gravel that is mostly 2 to 26 millimeters in diameter. Thickness of the solum and depth to the cinders range from 10 to 20 inches. The solum is 40 to 70 percent cinder gravel. The A1 horizon is brown or dark brown. The B2ca horizon is pale brown or light yellowish brown. The IIC horizon is dark gray or black.

Wupatki series

The Wupatki series consists of very shallow and shallow, well drained, moderately permeable soils on fan terraces and hillsides. These soils formed in pyroclastics. Slope ranges from 0 to 20 percent. The average annual precipitation is 8 to 14 inches, and the average annual air temperature is 52 to 55 degrees F.

These soils are cindery, mesic, shallow Aridic Durustolls.

Typical pedon of a Wupatki very cindery loam in an area of Wupatki-Wukoki very cindery loams, 0 to 15 percent slopes, about 4 miles east and 26 miles north of Flagstaff; 1,900 feet east of the northwest corner of sec. 7, T. 25 N., R. 8 E.

A11—0 to 1 inch; grayish brown (10YR 5/2) very cindery loam, dark brown (7.5YR 3/2) moist; weak very fine granular structure; soft, very friable, slightly sticky and nonplastic; common to many very fine and fine roots; cinders 2 to 26 millimeters in diameter on 50 to 55 percent of the surface; slightly effervescent; moderately alkaline; abrupt smooth boundary.

A12—1 inch to 6 inches; grayish brown (10YR 5/2) cindery loam, dark brown (7.5YR 3/2) moist; weak very fine and fine subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common to many very fine and fine roots; many very fine and fine tubular pores; 30 percent lime-coated cinders; slightly effervescent; moderately alkaline; clear smooth boundary.

B2ca—6 to 16 inches; grayish brown (10YR 5/2) very cindery loam, dark brown (10YR 3/3) moist; weak fine and medium granular structure; soft, very friable, slightly sticky and slightly plastic; few very fine and fine roots; common very fine and fine tubular pores; 55 percent lime-coated cinders; strongly effervescent; moderately alkaline; abrupt smooth boundary.

IIC1sicam—16 to 20 inches; white (10YR 8/2) silica- and lime-cemented duripan, very pale brown (10YR 7/3) moist; massive; thin laminar surface and lime pendants on the underside; strongly effervescent; strongly alkaline; clear smooth boundary.

IIIC2—20 to 60 inches; very dark gray (N 3/0) cinders, black (10YR 2/1) moist; single grain; loose; coatings of lime on some cinders.

Thickness of the solum and depth to the duripan range from 8 to 20 inches. The solum is mildly alkaline or moderately alkaline. The A horizon is brown, dark brown, or grayish brown. The B2ca horizon is pale brown, grayish brown, or dark brown. The C1sicam horizon is white, pale brown, pinkish white, pinkish gray, strong brown, or pink. The IIIC horizon is black, very dark gray, or dark gray.

Ziegler series

The Ziegler series consists of deep, well drained, slowly permeable soils on fan terraces and hillsides. These soils formed in alluvium derived from basalt and pyroclastics. Slope ranges from 0 to 30 percent. The average annual precipitation is 14 to 18 inches, and the average annual air temperature is 49 to 52 degrees F.

These soils are clayey over fragmental, montmorillonitic, mesic Aridic Argiustolls.

Typical pedon of Ziegler gravelly loam in an area of Ziegler-Wilaha association, strongly sloping, about 30 miles north of Flagstaff; 50 feet south and 2,600 feet east of the northwest corner of sec. 9, T. 26 N., R. 6 E.

A1—0 to 3 inches; reddish brown (5YR 5/3) gravelly loam, dark reddish brown (5YR 3/3) moist; moderate medium platy structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine roots; many very fine vesicular pores; 30 percent pebbles; moderately alkaline; clear smooth boundary.

B21t—3 to 7 inches; reddish brown (5YR 4/3) clay, dark reddish brown (5YR 3/3) moist; weak fine to

medium prismatic structure parting to moderate very fine and fine subangular blocky; hard, firm, sticky and plastic; many fine roots; common very fine and fine tubular and interstitial pores; many thin clay films on faces of peds and in pores; 10 percent cinders; moderately alkaline; clear wavy boundary.

B22tca—7 to 15 inches; reddish brown (5YR 4/4) clay, dark reddish brown (5YR 3/4) moist; moderate medium prismatic structure parting to moderate very fine and fine subangular blocky; hard, firm, sticky and plastic; many fine roots; common very fine and fine tubular and interstitial pores; common thin clay films on faces of peds and in pores; 10 percent cinders; strongly effervescent; few soft lime masses; moderately alkaline; clear wavy boundary.

IIB3tca—15 to 24 inches; brown (7.5YR 5/4) very cindery clay loam, reddish brown (5YR 4/4) moist; weak very fine granular structure; slightly hard, firm, sticky and plastic; many fine roots; common very fine and fine interstitial pores; 40 percent cinders; violently effervescent; moderately alkaline; clear wavy boundary.

IIICca—24 to 60 inches; cinders; lime coatings on some of the cinders.

Thickness of the solum and depth to cinders range from 20 to 40 inches. The solum is 10 to 30 percent cinder gravel. It is mildly alkaline or moderately alkaline. The A horizon is dark brown or reddish brown. The B2t horizon is dark reddish brown, dark red, or red. It is clay or cindery clay. The IIB3tca horizon is brown or reddish brown. It is weakly cemented with lime in places. The IIIC horizon is dark gray or very dark gray.

formation of the soils

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Soil is a complex, natural, three-dimensional body on the earth's surface that supports all life forms. It consists of inorganic and organic material. The nature and properties of soil have been determined by the physical, chemical, and biological processes that result from the interaction of five factors—climate, living organisms, parent material, topography, and time. The influence of any one of these factors varies from one location to another, but the interaction of all the factors determines the kind of soil that forms (*6, 19*).

During the last million years or so, the soils in this survey area have undergone dynamic changes. Volcanoes have erupted, streams have eroded the earth's surface and transported sediment to low-lying areas, eolian sediment has been deposited, and the climate and types of living organisms have changed. These various events have greatly influenced the properties of the soils in the area (*13, 17*).

In this section the five factors that affect soil formation in the survey area are discussed and the major processes are described.

climate

Climate has a profound influence on soil formation. Moisture and temperature directly affect the kind of living organisms that exist and the rate at which organic matter accumulates and decomposes and minerals weather. Moisture and temperature also influence the rate at which the weathered minerals accumulate in or are removed from soil horizons.

Winters in the survey area are cold, and a moderate amount of snow falls in winter. Thunderstorms accompanied by short periods of hard rains are common in July and August. Spring and fall are characterized by droughty periods, and strong winds occur from March through June. The relative humidity generally is low in summer and moderate in winter. All the soils in the survey area have a mesic soil temperature regime.

There are three major climatic zones in the survey area that influence soil formation: (1) areas that have an average annual precipitation of 6 to 10 inches, an average annual air temperature of 52 to 55 degrees F, strong winds in spring, and sparse desert shrub-grassland vegetation; (2) areas that have an average annual precipitation of 10 to 12 inches, an average annual air temperature of 50 to 54 degrees, strong winds in spring, and grassland vegetation; (3) areas that have an average annual precipitation of 12 to 18 inches, an average annual air temperature of 49 to 54 degrees, and woodland-grassland vegetation (*10*).

The 6- to 10-inch precipitation zone is along the Little Colorado River. Soils in this zone have an aridic or torric soil moisture regime and are low in content of organic matter and clay-sized particles. The surface layer of these soils is influenced by eolian deposits. Examples of soils that formed in this zone are those of the Epikom and Purgatory series.

The 10- to 12-inch precipitation zone is characterized by soils that have an aridic or torric soil moisture regime that borders on an ustic moisture regime. The content of organic matter commonly is more than 1 percent in the thin A horizon of these soils. The soils in this zone that formed in clayey alluvium on older surfaces have an argillic or cambic horizon. Eolian deposits provide a source of secondary enrichment with carbonates and other soluble salts. Examples of soils that formed in this zone are those in the Winona, Clovis, and Poley series.

The 12- to 18-inch precipitation zone has an ustic soil moisture regime. Because of the increased precipitation, the plant community of the soils in this zone is composed of juniper, pinyon, and grasses. Soils such as those in the Thunderbird and Disterheff series formed in this zone.

living organisms

Living organisms, particularly plants, have a significant influence on soil formation. Decaying plant material such as fibrous grass roots is the main source of organic matter. Dieback of large plants promotes deep penetration of water. Plants of all sizes intercept precipitation, reduce soil erosion, trap sediment, and help to aerate the soils.

Animals influence soil formation by contributing and synthesizing organic matter. Animals also mix soil horizons by burrowing and turning soil material while feeding or foraging. Vertebrate animals such as small rodents turn and mix the soil material, and invertebrates such as insects, earthworms, and micro-organisms synthesize organic matter (*1*). The number of invertebrates in the soil depends on the content of

organic matter and moisture. Earthworms are scarce in this area. Low organic matter content, low soil moisture, and abundant carbonates adversely affect populations of fauna in the soil.

Accumulated plant remains and inherited organic matter in alluvial deposits have provided varying amounts of organic matter to the soils in this area. In the 6- to 10-inch precipitation zone, plant remains have accumulated slowly and dissipated rapidly. The 12- to 18-inch precipitation zone has a vegetative environment that is a combination of increased precipitation and cooler temperatures during the growing season. Ustollic subgroups that occur in the 10- to 12-inch precipitation zone are transitional areas. Coppice dunes are common in level areas that have sparse vegetation and are subject to strong winds (*12*). These dunes are eolian deposits that have accumulated around the base of shrubs.

parent material

This section describes the ancestral drainage patterns and the paleoclimate in the survey area. Then it discusses soil parent material sources and the mechanisms for sediment transportation.

The Colorado River serves as baselevel for most of the survey area. The Little Colorado River is the only other large and active drainageway. Evolution of the major drainageways is believed to have occurred in the Eocene or Oligocene epochs, prior to the mountain-building associated with the Central Arizona uplift. The ancestral rivers flowed in a southeasterly direction on a gentle gradient from Utah and northwestern Arizona into New Mexico. Subsequent upwarping caused the drainageways to flow in a northeasterly direction. Faulting and volcanism caused downcutting that initiated the modern drainage, which flows in a south-southwesterly direction. Initially, the downcutting was drastic and rapid. The rate of incision has slowed substantially during the last million years (*9, 11*).

It is believed that when the ancestral Colorado River was associated with the Rio Grande System it flowed in a southeasterly direction. Cross-bedding records in sandstone seem to substantiate this hypothesis. Uplifting of the southern end of the Colorado Plateau was followed by entrenchment and reversal of drainageways. This created swampy areas and left deposits of silty and clayey sediment behind.

Tectonics and volcanism have been major factors influencing erosion and deposition on a regional scale. However, cyclic change in the paleoclimate, affected by Quaternary glaciations and interglaciations in adjacent mountains, has been the main factor controlling depositional processes in individual basins and river valley segments. These alluvial deposits reflect cyclic shifts in hydrologic regimes and related changes in vegetation caused by the sudden changes in climate.

Glacial melting corresponds with episodes of increased river discharge, entrenchment of major valleys, and flooding. Aridity increased during the transition from glacial to interglacial periods. This resulted in less plant cover and in widespread erosion and sedimentation during infrequent thunderstorm-runoff events. Aerial deflation and subsequent eolian deposition affected large areas, particularly those areas lacking good plant cover. Calcareous dust was blown about freely throughout the area.

The survey area is within the Grand Canyon section of the Colorado physiographic province. This section is further divided into the Coconino Plateau and San Francisco Plateau (*8*). The main criterion for the subdivision is the relative abundance of volcanic rock on the San Francisco Plateau compared to the horizontally oriented sedimentary rock on the Coconino Plateau.

The geologic history of the survey area is recorded by outcroppings of rock that span an interval of about 300 million years (*4*). The oldest rocks are of Mississippian age and are of minor extent in the area. They include the Redwall and Martin Limestone in the extreme southwestern part of the area. The Supai Formation, consisting of sandstone and shale of Permian age, is limited to areas north of Seligman and near Meteor Crater, in the eastern part of the area. Hermit Shale of Permian age is exposed in Cataract Creek Canyon, in the northern part of the area.

Sandstone, mainly Coconino Sandstone of Permian age, is common north of Seligman and Ashfork. Calciustolls such as Deama soils formed in material derived from this sandstone.

During Permian time, the sea covered much of Arizona and sediment was deposited over the Coconino Sandstone. Kaibab Limestone formed from this sediment. It is extensive across the Coconino Plateau and in a large area in the southeastern part of the survey area. Regional upwarping caused the sea to retreat, and widespread erosion occurred at the close of the Paleozoic. Calciorthids such as Winona soils formed in material derived from Kaibab Limestone.

During the Triassic Period, sediment was deposited under the influence of a near-shore, continental environment. The Moenkopi Formation, which consists of locally gypsiferous mudstone, shale, siltstone, and sandstone, formed in this sediment. Erosion subsequently removed the Moenkopi Formation from much of the survey area, and it is now present mainly in outlying areas of the Coconino Plateau and in the Little Colorado River Valley, in the southeastern part of the area. The main soils in these areas are those of the Epikom series, which are Camborthids, and the Purgatory series, which are Gypsiorthids.

Quaternary-Tertiary volcanics, consisting of basaltic flows, tuff, agglomerate, and some andesite, are the most prominent types of rock in the western part of the area, around Mt. Floyd. Pyroclastic rock such as tuff and agglomerate weathers to produce a significant amount of montmorillonitic clay, which is the source of highly mobile and widespread alluvium. Ustolls and Usterts

such as Thunderbird and Springerville soils formed in this clay.

The central part of the survey area is within the San Francisco Volcanic Field (*18*). In the past this area has undergone intensive volcanic activity. Lava caps many of the mesas and valley floors in this area. Cinder cones or the eroded remnants of cinder cones dot the landscape. Ustolls, such as Nalaki and Wukoki soils, are commonly associated with cinder cones.

topography and time

Each major landform in the survey area represents an episode of landscape development. These landforms and their associated soils are described in the following paragraphs (figs. 5, 6, and 7).

Flood plains. These Holocene landforms developed in calcareous alluvial material deposited by graded channels of the Little Colorado River. Flood plains are characterized by low undulating bars and broad channels that resulted from periodic floods. Each flood caused rapid changes in the landscape. New channels were cut as older channels were abandoned, and new alluvium was deposited as floodwater receded. Soils that formed in the stream deposits on flood plains include Torrifluvents such as the Navajo soils. These young soils formed in fine sediment. They have an irregular decrease in organic carbon content as depth increases. Because the soils on flood plains have received periodic additions of fresh alluvium, their development has been inhibited.

Alluvial fans. These Holocene landforms are part of broad coalescent plains covered with alluvial material. They consist of sand, silt, clay, and rock fragments and are characterized by numerous braided streams and shallow channels. During periods of flooding, the shallow channels do not have the capacity to carry the runoff; consequently, the excess water overflows the banks of the channels and alluvium is spread across the surface. Periods of flooding are infrequent, but they are

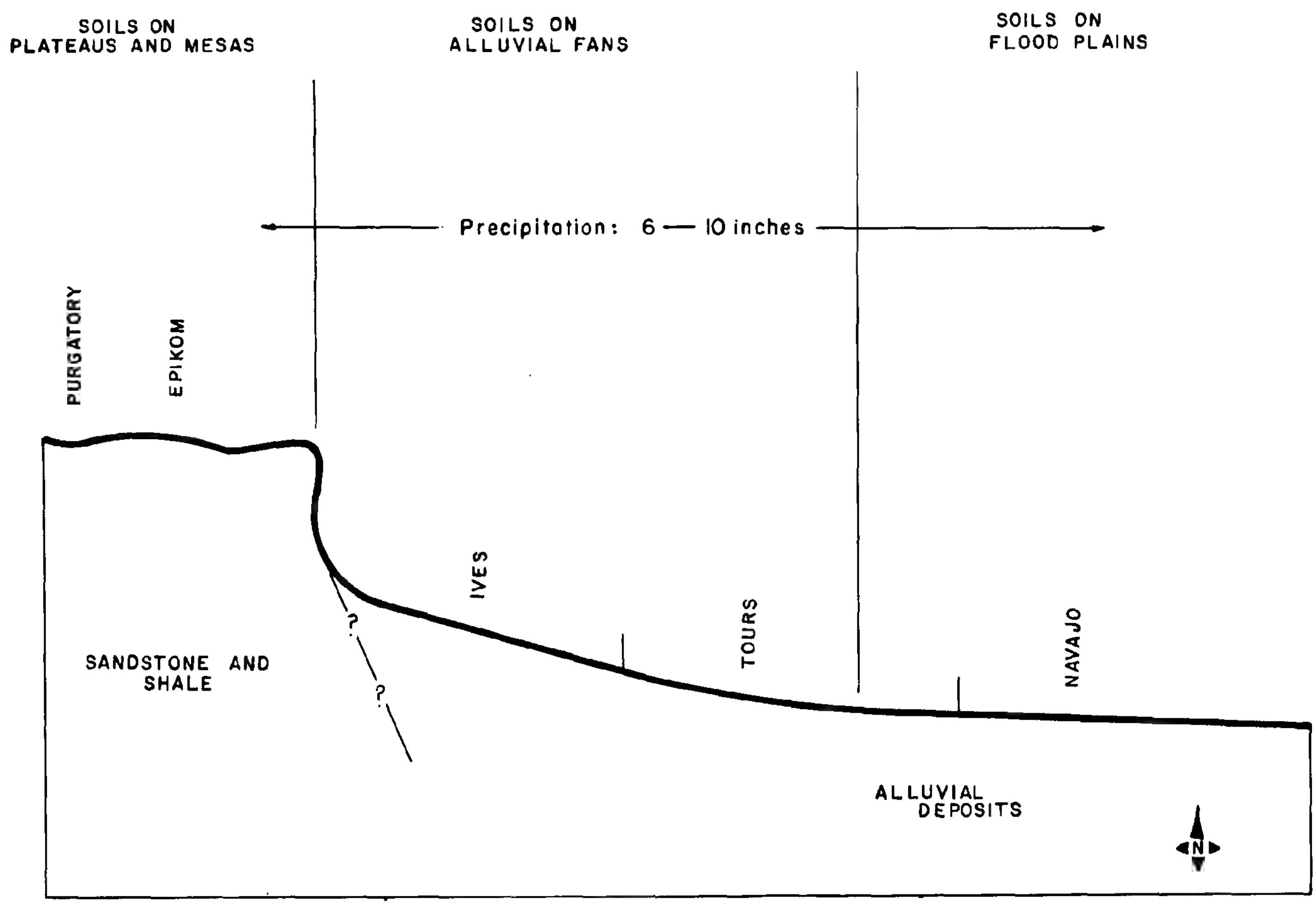

Figure 5.—Soil-landscape profile on Tucker Mesa.

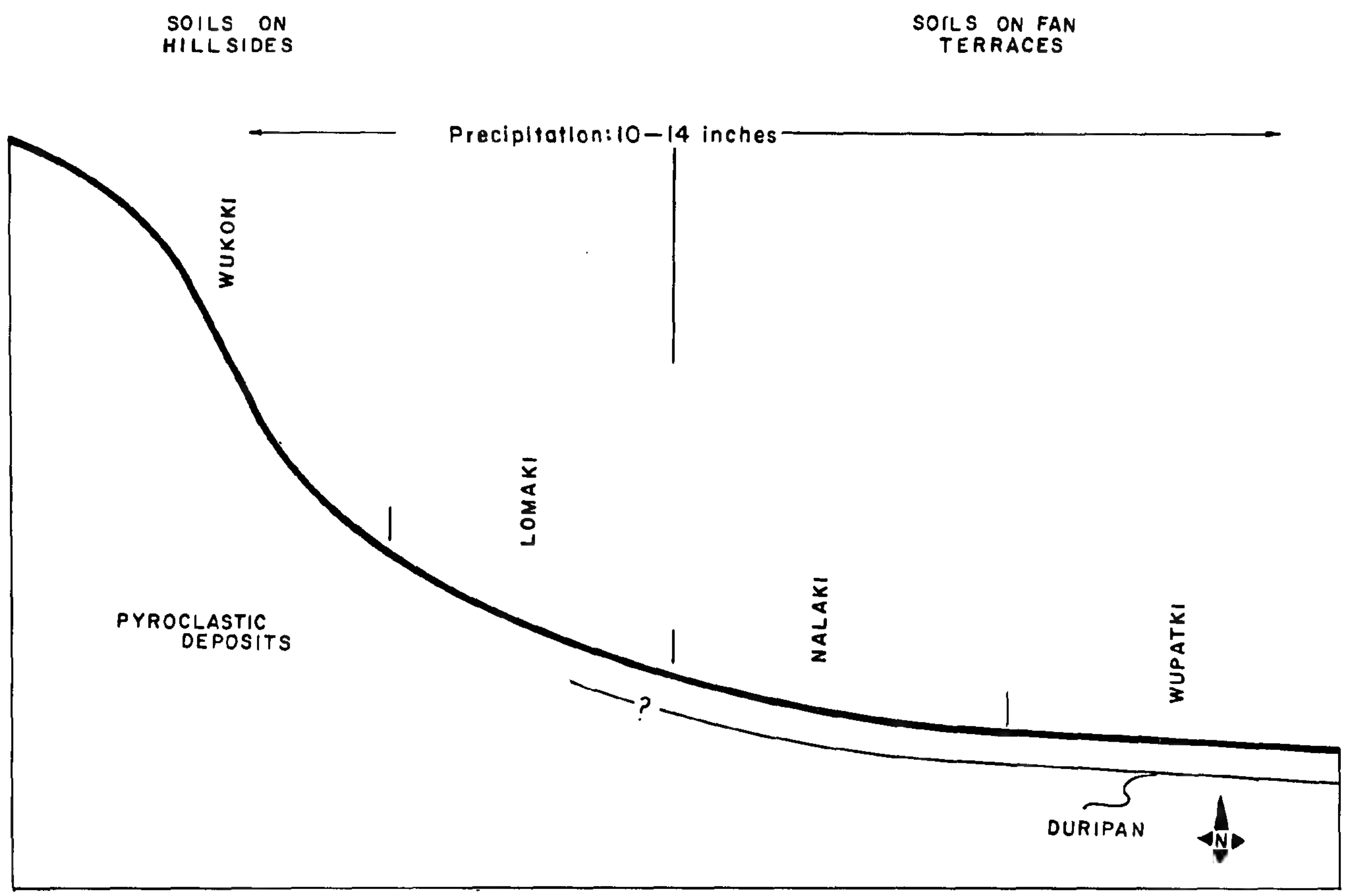

Figure 6.—Soil-landscape profile on SP Mountain.

sometimes violent. Because soil formation has not begun, only a limited amount of carbonates has been transferred within the calcareous parent material. In areas adjacent to the Little Colorado River, the alluvial fans grade to flood plains. Representative soils on alluvial fans are those in the Ives and Tours series. These soils are highly stratified and calcareous, which is evidence of a lack of soil development. The organic matter content irregularly decreases with depth in these soils. These soils are classified as Torrifluvents (*20*).

Stream terraces. These Holocene landforms are abandoned flood plains that were formed when the streams flowed at a higher level. The extent of these landforms is limited in the survey area. Stream terraces are no longer subject to overflow (*14*). The alluvial deposits in these areas commonly are stratified below a depth of 3 feet. Typical soils on stream terraces include the Rune and Tenorio soils. The Rune soils do not have an argillic horizon but have a thick mollic epipedon and are classified as Haplustolls. The Tenorio soils have an argillic horizon and an ochric epipedon, and they are classified as Haplargids.

Fan terraces. These landforms are characterized by broad coalescent plains that have been incised by streams. They are late Pleistocene or older. Local relief and the amount of dissection are variable. These surfaces were formed during multiple episodes of incision and backfilling. The particle-size distribution and mineralogy of the alluvial deposits are diverse. The lithology of the hillsides above the valley influences the nature of the parent material.

The kind of soils that formed on fan terraces is related to the amount of clay-sized particles, rock fragments, and secondary carbonates inherited from alluvial and eolian deposits. Representative soils on the fan terraces are the Disterheff, Nalaki, and Wupatki soils. The Disterheff soils have an argillic horizon and an ochric epipedon and are classified as Haplustalfs. Nalaki and Wupatki soils on fan terraces are associated with cinder cones that have a strongly cemented, continuous duripan. Accumulation of soluble silica combined with

carbonates has resulted in the development of a strongly cemented duripan. The Nalaki and Wupatki soils also have a mollic epipedon.

Plateaus and mesas. Plateaus are extensive gently sloping to undulating plains, and mesas are isolated tablelands. Both of these landforms have a resistant cap rock that is essentially horizontal. These landforms are mid-Pleistocene or older. Most areas consist of old erosional surfaces that have a thin mantle of alluvial and eolian deposits over bedrock. Representative soils on these landforms are those in the Epikom and Winona series. These soils are Orthids that have been influenced by eolian deposits of carbonates and gypsum. Also associated with these landforms are Kopie soils, which are Ustochrepts.

Hillsides. These landforms are characterized by undulating to moderately steep Pleistocene landscapes with occasional steep Holocene landforms. They consist of the area below the summits and include the moderately steep backslopes. Slopes typically are less than 30 percent, but they are as much as 90 percent. Most soils on hillsides are less than 40 inches deep to bedrock. The parent material includes basalt, tuff, agglomerate, andesite, pyroclastics, sandstone, and limestone. Typical soils on hillsides are those of the Ashfork, Cabezon, Daze, Deama, Lomaki, Tovar, and Wukoki series. The Tovar soils have an argillic horizon and an ochric epipedon and are classified as Haplustalfs. The Deama soils have a mollic epipedon, a calcic horizon, and carbonatic mineralogy. They are classified as Calciustolls. The Ashfork, Cabezon, Daze, and Thunderbird soils have an argillic horizon and a mollic epipedon and are classified as Argiustolls. The Wukoki and Lomaki soils formed in cinders and volcanic ash, have a mollic epipedon, and are classified as Haplustolls.

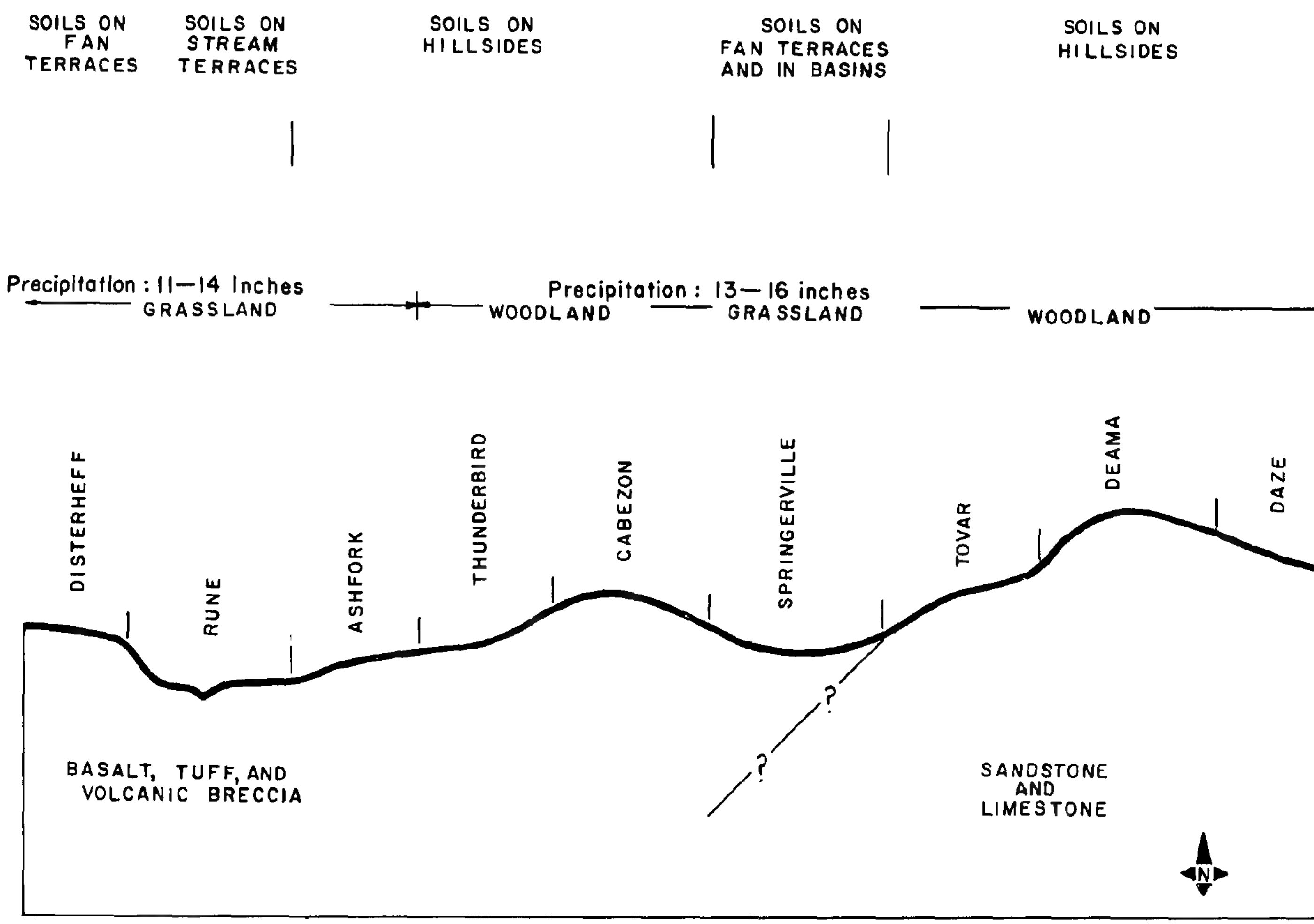

Figure 7.—Soil-landscape profile in an area north of Seligman.

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glossary

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Alluvial fan. A body of alluvium, with or without debris flow deposits, whose surface forms a segment of a cone that radiates downslope from the point where the stream emerges from a narrow valley onto a plain. Common longitudinal profiles are gently sloping and nearly linear. Source uplands range in relief and areal extent from mountains and plateaus to gullied hills and piedmonts.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3.5
Low	3.5 to 5.0
Moderate	5.0 to 7.5
High	More than 7.5

Basin. A broad structural lowland, commonly elongated and many miles across, between mountain ranges. Major component landforms are basin floors and piedmonts. Floors of internally drained basins contain one or more closed depressional areas, with temporary lakes and alluvial plains. In basins with through drainage, alluvial plains are dominant and lakes are absent or of small extent.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Caliche. A more or less cemented deposit of calcium carbonate in soils of warm-temperate, subhumid to arid areas. Caliche occurs as soft, thin layers in the soil or as hard, thick beds just beneath the solum, or it is exposed at the surface by erosion.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity, but is more precise in meaning.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Claypan. A slowly permeable soil horizon that contains much more clay than the horizons above it. A claypan is commonly hard when dry and plastic or stiff when wet.

Climax vegetation. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse fragments. Mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter.

Coarse textured soil. Sand or loamy sand.

Cobblestone (or cobble). A rounded or partly rounded fragment of rock 3 to 10 inches (7.5 to 25 centimeters) in diameter.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Deferred grazing. Postponing grazing or arresting grazing for a prescribed period.

Depth to rock. Bedrock is too near the surface for the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically for long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the

building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Excess lime (in tables). Excess carbonates in the soil that restrict the growth of some plants.

Excess salts (in tables). Excess water-soluble salts in the soil that restrict the growth of most plants.

Fan terrace. A relict alluvial fan no longer a site of active deposition; incised by younger and lower lying alluvial surfaces.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fine textured soil. Sandy clay, silty clay, and clay.

Flagstone. A thin fragment of sandstone, limestone, slate, shale, or (rarely) schist, 6 to 15 inches (15 to 37.5 centimeters) long.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Forb. Any herbaceous plant not a grass or a sedge.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Geomorphic surface. A landform or group of landforms that represents an episode of landscape development.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.5 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.5 centimeters) in diameter.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Hardpan. A hardened or cemented soil horizon, or layer. The soil material is sandy, loamy, or clayey and is cemented by iron oxide, silica, calcium carbonate, or other substance.

Hillside. The steeper part of a hill between its summit and the drainage line, valley flat, or depressional floor at the base of the hill. In descending order, geomorphic components may include shoulder, backslope, foot slope, and toe slope; however, all of these are not necessarily present in any given hillside continuum.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. The major horizons of mineral soil are as follows:

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

A2 horizon.—A mineral horizon, mainly a residual concentration of sand and silt high in content of resistant minerals as a result of the loss of silicate clay, iron, aluminum, or a combination of these.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil does not have a B horizon, the A horizon alone is the solum.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, the Roman numeral II precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface,

have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, invader plants follow disturbance of the surface.

Lacustrine deposit (geology). Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Mesa. A broad, nearly flat-topped and usually isolated upland mass characterized by summit widths that are greater than the heights of bounding erosional scarps.

Miscellaneous areas. Areas that have little or no natural soil and support little or no vegetation.

Moderately coarse textured (moderately light textured) soil. Sandy loam and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Pan. A compact, dense layer in a soil that impedes the movement of water and the growth of roots. For example, *hardpan, claypan, plowpan,* and *traffic pan.*

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Permafrost. Layers of soil, or even bedrock, occurring in arctic or subarctic regions, in which a temperature below freezing has existed continuously for a long time.

Permeability. The quality that enables the soil to transmit water or air, measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.20 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, differences in slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plateau. An extensive upland mass with relatively flat summit area that is considerably elevated (more than 100 meters) above adjacent lowlands and is separated from them on one or more sides by escarpments.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Rangeland. Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Range condition. The present composition of the plant community on a range site in relation to the potential natural plant community for that site. Range condition is expressed as excellent, good, fair, or poor, on the basis of how much the present plant community has departed from the potential.

Range site. An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other range sites in kind or proportion of species or total production

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	Below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered, or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rippable. Bedrock or hardpan can be excavated using a single-tooth ripping attachment mounted on a tractor with a 200-300 draw bar horsepower rating.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-size particles.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have about the same profile, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silica. A combination of silicon and oxygen. The mineral form is called quartz.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Sinkhole. A depression in the landscape where limestone has been dissolved.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Small stones (in tables). Rock fragments less than 3 inches (7.5 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Solution cavity. An opening resulting from the decomposition of less soluble rock by water penetrating pre-existing interstices or fractures, followed by solution and removal of the decomposition products.

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stream terrace. One of a series of platforms in a stream valley, flanking and more or less parallel to the stream channel, originally formed near the level of the stream and representing the dissected remnants of an abandoned flood plain, streambed, or valley floor produced during a former stage of erosion or deposition.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular. Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Subsurface layer. Technically, the A2 horizon. Generally refers to a leached horizon lighter in color and lower in content of organic matter than the overlying surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt, silt loam, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or " very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

Variegation. Refers to patterns of contrasting colors assumed to be inherited from the parent material rather than to be the result of poor drainage.

Water supplying capacity. Available water in the soil at the start of the growing season plus precipitation, less runoff and evaporation, *or* plus run-on from higher lying areas.

tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

[Recorded in the period 1951-75 at Seligman, Ariz.]

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average daily	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days[1]	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January----	52.7	21.4	37.1	71	-1	91	.85	.20	1.37	2	1.9
February---	56.6	23.9	40.3	77	5	128	.64	.06	1.07	2	1.4
March------	61.9	26.7	44.3	79	11	163	.96	.13	1.60	3	3.6
April------	69.5	32.8	51.1	86	18	343	.53	.01	.90	2	.1
May--------	78.4	39.7	59.1	93	23	592	.28	.00	.49	1	.0
June-------	87.6	47.3	67.5	102	34	825	.61	.10	1.01	1	.0
July-------	92.1	56.0	74.1	102	42	1,057	1.84	.68	2.77	4	.0
August-----	89.1	55.1	72.1	99	42	995	2.44	1.16	3.47	6	.0
September--	85.6	47.7	66.7	96	35	801	.83	.05	1.41	2	.0
October----	76.4	37.9	57.2	90	22	533	.61	.13	.99	1	.0
November---	63.1	28.2	45.7	80	12	189	.63	.06	1.07	2	1.1
December---	54.2	21.6	37.9	70	2	96	1.05	.05	1.79	2	4.9
Year-------	72.3	36.5	54.4	103	-4	5,813	11.27	8.05	14.26	28	13.0

[1] A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (40° F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

[Recorded in the period 1951-75 at Seligman, Ariz.]

Probability	Temperature: 24° F or lower	Temperature: 28° F or lower	Temperature: 32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	May 14	May 26	May 31
2 years in 10 later than--	May 6	May 19	May 26
5 years in 10 later than--	April 22	May 6	May 16
First freezing temperature in fall:			
1 year in 10 earlier than--	October 16	October 9	September 23
2 years in 10 earlier than--	October 22	October 15	September 30
5 years in 10 earlier than--	November 3	October 26	October 13

TABLE 3.--GROWING SEASON

[Recorded in the period 1951-75 at Seligman, Ariz.]

Probability	Daily minimum temperature: Higher than 24° F	Daily minimum temperature: Higher than 28° F	Daily minimum temperature: Higher than 32° F
	Days	Days	Days
9 years in 10	166	147	124
8 years in 10	176	156	133
5 years in 10	195	173	150
2 years in 10	215	190	167
1 year in 10	225	199	175

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
1	Ashfork gravelly clay loam, 1 to 15 percent slopes	58,960	2.5
2	Aut gravelly loam, 0 to 8 percent slopes	19,745	0.9
3	Aut-Cross association, moderately sloping	29,295	1.3
4	Aut-Lynx association, gently sloping	805	*
5	Badland-Torriorthents complex, moderately steep	11,200	0.5
6	Boquillas-Seligman complex, 1 to 15 percent slopes	12,060	0.5
7	Clovis loamy sand, 1 to 8 percent slopes	12,220	0.5
8	Cross-Apache complex, 2 to 15 percent slopes	7,320	0.3
9	Daze-Deama association, moderately steep	29,785	1.3
10	Deama gravelly loam, 2 to 15 percent slopes	69,830	3.0
11	Deama stony loam, 1 to 15 percent slopes	45,990	2.0
12	Deama-Rock outcrop complex, 8 to 30 percent slopes	58,235	2.5
13	Deama-Toqui complex, 0 to 8 percent slopes	35,655	1.5
14	Deama-Tovar association, steep	19,220	0.8
15	Disterheff very gravelly sandy clay loam, 1 to 15 percent slopes	74,050	3.2
16	Disterheff-Kopie association, moderately sloping	8,885	0.4
17	Epikom very cindery loamy sand, 0 to 5 percent slopes	4,665	0.2
18	Epikom complex, 0 to 15 percent slopes	108,490	4.7
19	Epikom-Rock outcrop complex, 8 to 60 percent slopes	29,750	1.3
20	Faraway-Rock outcrop complex, 20 to 80 percent slopes	6,745	0.3
21	Keeseha-Poley gravelly sandy loams, 0 to 8 percent slopes	18,880	0.8
22	Kopie-Servilleta association, moderately sloping	21,590	0.9
23	Lava flows	1,675	0.1
24	Lomaki-Nalaki very cindery loams, 0 to 8 percent slopes	22,350	1.0
25	Mespun-Palma complex, 1 to 8 percent slopes	4,020	0.2
26	Navajo clay, 0 to 5 percent slopes	1,840	0.1
27	Palma sandy loam, 0 to 5 percent slopes	4,340	0.2
28	Pastura gravelly loam, 0 to 8 percent slopes	8,245	0.4
29	Paymaster-Lynx association, gently sloping	15,840	0.7
30	Poley sandy loam, 0 to 5 percent slopes	13,525	0.6
31	Poley gravelly loam, 0 to 8 percent slopes	41,715	1.8
32	Poley-Lynx association, gently sloping	16,255	0.7
33	Poley-Tusayan association, gently sloping	46,850	2.0
34	Purgatory gravelly fine sandy loam, 0 to 8 percent slopes	27,670	1.2
35	Quivera very gravelly loam, 0 to 8 percent slopes	9,895	0.4
36	Riverwash	1,240	0.1
37	Rune silty clay loam, 0 to 8 percent slopes	36,035	1.6
38	Rune-Disterheff association, gently sloping	41,905	1.8
39	Servilleta fine sandy loam, 1 to 8 percent slopes	2,620	0.1
40	Servilleta-Tusayan complex, 1 to 8 percent slopes	33,385	1.4
41	Showlow gravelly fine sandy loam, 0 to 8 percent slopes	4,140	0.2
42	Showlow gravelly fine sandy loam, 8 to 30 percent slopes	20,835	0.9
43	Springerville cobbly clay, 0 to 8 percent slopes	28,020	1.2
44	Springerville very stony clay, 0 to 8 percent slopes	15,390	0.7
45	Tajo-Springerville complex, 0 to 15 percent slopes	2,565	0.1
46	Tenorio very gravelly sandy loam, 0 to 8 percent slopes	7,275	0.3
47	Thunderbird-Cabezon complex, 2 to 30 percent slopes	21,945	0.9
48	Thunderbird-Rock outcrop complex, 30 to 60 percent slopes	40,085	1.7
49	Thunderbird-Springerville association, strongly sloping	92,235	4.0
50	Torrifluvents, saline	1,270	0.1
51	Tours silty clay loam, 0 to 8 percent slopes	13,995	0.6
52	Tours-Ives association, gently sloping	7,285	0.3
53	Tovar complex, 2 to 25 percent slopes	12,555	0.5
54	Tovar complex, 25 to 60 percent slopes	7,105	0.3
55	Tusayan-Lynx association, gently sloping	10,360	0.4
56	Tuweep very gravelly loam, 0 to 15 percent slopes	37,295	1.6
57	Valle gravelly silt loam, 0 to 8 percent slopes	2,235	0.1
58	Wilaha cindery loam, 2 to 30 percent slopes	7,870	0.3
59	Wilaha-Wukoki association, steep	3,525	0.2
60	Winona gravelly loam, 0 to 8 percent slopes	150,095	6.5
61	Winona stony loam, 0 to 8 percent slopes	212,550	9.2
62	Winona-Boysag gravelly loams, 0 to 8 percent slopes	325,965	14.1
63	Winona-Epikom association, gently sloping	33,605	1.5
64	Winona-Rock outcrop complex, 15 to 30 percent slopes	74,440	3.2
65	Winona-Rock outcrop complex, 30 to 70 percent slopes	40,755	1.8
66	Winona-Tusayan association, gently sloping	36,835	1.6
67	Wukoki-Rock outcrop complex, 5 to 25 percent slopes	14,520	0.6

See footnote at end of table.

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS--Continued

Map symbol	Soil name	Acres	Percent
68	Wukoki-Wupatki very cindery loams, 15 to 60 percent slopes	13,890	0.6
69	Wupatki-Wukoki very cindery loams, 0 to 15 percent slopes	16,030	0.7
70	Ziegler gravelly loam, 0 to 8 percent slopes	4,800	0.2
71	Ziegler-Cross association, moderately sloping	28,295	1.2
72	Ziegler-Wilaha association, strongly sloping	13,455	0.6
	Total	2,314,000	100.0

* Less than 0.1 percent.

TABLE 5.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES

[Only the soils that support rangeland vegetation suitable for grazing are listed]

Soil name and map symbol	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Compo-sition
			Lb/acre		Pct
1: Ashfork	Clay Loam Upland, 10- to 14-inch precipitation zone	Favorable	900	Blue grama	20
		Normal	600	Galleta	15
		Unfavorable	550	Pinyon	10
				Oneseed juniper	10
				Western wheatgrass	10
				Needleandthread	5
				Broom snakeweed	5
				Aster	5
				Bottlebrush squirreltail	5
				Black grama	5
2: Aut	Loamy Upland, 10- to 14-inch precipitation zone	Favorable	1,000	Winterfat	20
		Normal	700	Blue grama	15
		Unfavorable	500	Needleandthread	15
				Alkali sacaton	10
				Black grama	5
				Galleta	5
				Indian ricegrass	5
				Threeawn	5
				Oneseed juniper	5
				Bottlebrush squirreltail	5
				Sand dropseed	5
3*:					
Aut	Loamy Upland, 10- to 14-inch precipitation zone	Favorable	1,000	Winterfat	20
		Normal	700	Blue grama	15
		Unfavorable	500	Needleandthread	15
				Alkali sacaton	10
				Black grama	5
				Galleta	5
				Indian ricegrass	5
				Threeawn	5
				Oneseed juniper	5
				Bottlebrush squirreltail	5
				Sand dropseed	5
Cross	Shallow Loamy, 10- to 14-inch precipitation zone	Favorable	800	Sideoats grama	20
		Normal	600	Blue grama	15
		Unfavorable	500	Galleta	15
				Black grama	10
				New Mexico feathergrass	10
				Oneseed juniper	10
				Bottlebrush squirreltail	5
4*:					
Aut	Loamy Upland, 10- to 14-inch precipitation zone	Favorable	1,000	Winterfat	20
		Normal	700	Blue grama	15
		Unfavorable	500	Needleandthread	15
				Alkali sacaton	10
				Black grama	5
				Galleta	5
				Indian ricegrass	5
				Threeawn	5
				Oneseed juniper	5
				Bottlebrush squirreltail	5
				Sand dropseed	5

See footnote at end of table.

TABLE 5.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
4*:					
Lynx	Loamy Bottom, 10- to 14-inch precipitation zone	Favorable	1,700	Western wheatgrass	30
		Normal	1,400	Blue grama	15
		Unfavorable	1,100	Vine-mesquite	10
				Fourwing saltbush	10
				Spike muhly	10
				Sideoats grama	5
				Winterfat	5
				Bottlebrush squirreltail	5
				Muttongrass	5
5*:					
Badland.					
Torriorthents	Loamy Upland, 6- to 10-inch precipitation zone	Favorable	700	Alkali sacaton	15
		Normal	500	Black grama	15
		Unfavorable	300	Blue grama	10
				Indian ricegrass	10
				Needleandthread	5
				Bottlebrush squirreltail	5
				Galleta	5
				Fourwing saltbush	5
				Winterfat	5
				Mormon-tea	5
7 Clovis	Sandy Loam Upland, 10- to 14-inch precipitation zone	Favorable	1,150	Blue grama	25
		Normal	600	Galleta	15
		Unfavorable	350	Indian ricegrass	10
				Black grama	10
				Winterfat	10
				Sand dropseed	5
				Needleandthread	5
				Bottlebrush squirreltail	5
				Fourwing saltbush	5
				Oneseed juniper	5
8*:					
Cross	Shallow Loamy, 10- to 14-inch precipitation zone	Favorable	800	Sideoats grama	20
		Normal	600	Blue grama	15
		Unfavorable	500	Galleta	15
				Black grama	10
				New Mexico feathergrass	10
				Oneseed juniper	10
				Bottlebrush squirreltail	5
				Winterfat	5
				Utah juniper	5
Apache	Shallow Loamy, 12- to 16-inch precipitation zone	Favorable	950	Sideoats grama	20
		Normal	700	Needleandthread	15
		Unfavorable	600	Black grama	15
				Blue grama	10
				Bottlebrush squirreltail	5
				New Mexico feathergrass	5
				Muttongrass	5
				Fourwing saltbush	5
				Bigelow sagebrush	5
				Turbinella oak	5
				Mexican cliffrose	5
				Juniper	5

See footnote at end of table.

TABLE 5.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
)*:					
Daze	Shallow Loamy, 10- to 14-inch precipitation zone	Favorable	800	Blue grama	15
		Normal	650	Sideoats grama	10
		Unfavorable	500	Black grama	10
				Needleandthread	10
				Hairy grama	5
				Wolftail	5
				Winterfat	5
				Fourwing saltbush	5
				Utah juniper	5
				Pinyon	5
				Turbinella oak	5
				New Mexico feathergrass	5
Deama.					
14*:					
Deama	Breaks, 14- to 18-inch precipitation zone	Favorable	900	Blue grama	15
		Normal	700	Needleandthread	15
		Unfavorable	500	Sideoats grama	10
				Black grama	10
				Juniper	10
				Muttongrass	5
				Bottlebrush squirreltail	5
				Mexican cliffrose	5
				Turbinella oak	5
				Skunkbush sumac	5
				Pinyon	5
Tovar	Breaks, 14- to 18-inch precipitation zone	Favorable	1,500	Blue grama	20
		Normal	1,200	Western wheatgrass	15
		Unfavorable	800	Sideoats grama	10
				Muttongrass	10
				Galleta	10
				Black grama	5
				Needleandthread	5
				Bottlebrush squirreltail	5
				Winterfat	5
				Juniper	5
				Pinyon	5
15 Disterheff	Clay Loam Upland, 10- to 14-inch precipitation zone	Favorable	1,000	Western wheatgrass	15
		Normal	650	Galleta	15
		Unfavorable	300	Black grama	10
				Blue grama	10
				Sideoats grama	10
				Needleandthread	5
				Muttongrass	5
				Winterfat	5
				Fourwing saltbush	5
				Utah juniper	5
				Oneseed juniper	5
16*:					
Disterheff	Clay Loam Upland, 10- to 14-inch precipitation zone	Favorable	1,000	Western wheatgrass	15
		Normal	650	Galleta	15
		Unfavorable	300	Sideoats grama	10
				Blue grama	10
				Black grama	10
				Needleandthread	5
				Muttongrass	5
				Winterfat	5
				Fourwing saltbush	5
				Utah juniper	5
				Oneseed juniper	5

See footnote at end of table.

TABLE 5.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
16*:					
Kopie	Sandstone Upland, 10- to 14-inch precipitation zone	Favorable	900	Black grama	15
		Normal	750	Indian ricegrass	10
		Unfavorable	600	New Mexico feathergrass	10
				Fourwing saltbush	10
				Bottlebrush squirreltail	5
				Blue grama	5
				Fremont mahonia	5
				Four-o'clock	5
				Aster	5
				Broom snakeweed	5
				Wolfberry	5
17 Epikom	Sandstone Upland, 6- to 10-inch precipitation zone	Favorable	650	Galleta	25
		Normal	500	Black grama	15
		Unfavorable	300	Alkali sacaton	15
				Blue grama	10
				Fourwing saltbush	10
				Bigelow sagebrush	10
				Bottlebrush squirreltail	5
18*:					
Epikom, fine sandy loam	Sandstone Upland, 6- to 10-inch precipitation zone	Favorable	650	Galleta	25
		Normal	500	Black grama	15
		Unfavorable	300	Alkali sacaton	15
				Blue grama	10
				Fourwing saltbush	10
				Bigelow sagebrush	10
				Bottlebrush squirreltail	5
Epikom, gravelly fine sandy loam	Sandstone Upland, 6- to 10-inch precipitation zone	Favorable	650	Galleta	25
		Normal	500	Black grama	15
		Unfavorable	300	Alkali sacaton	15
				Blue grama	10
				Fourwing saltbush	10
				Bigelow sagebrush	10
				Bottlebrush squirreltail	5
19*:					
Epikom	Breaks, 6- to 10-inch precipitation zone	Favorable	650	Galleta	25
		Normal	500	Black grama	15
		Unfavorable	300	Alkali sacaton	15
				Blue grama	10
				Fourwing saltbush	10
				Bigelow sagebrush	10
				Bottlebrush squirreltail	5
Rock outcrop.					
20*:					
Faraway	Breaks, 14- to 18-inch precipitation zone	Favorable	1,200	Sideoats grama	15
		Normal	750	Needleandthread	10
		Unfavorable	600	Black grama	10
				Blue grama	10
				Juniper	10
				Pinyon	10
				Turbinella oak	10
				Muttongrass	5
				Bottlebrush squirreltail	5
				Skunkbush sumac	5
				Shrubby buckwheat	5

See footnote at end of table.

TABLE 5.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
20*:					
Rock outcrop.					
21*:					
Keeseha	Sandy Loam Upland, 10- to 14-inch precipitation zone	Favorable	1,000	Black grama	15
		Normal	700	Needleandthread	15
		Unfavorable	400	Indian ricegrass	15
				Galleta	10
				Blue grama	10
				Sand dropseed	10
				Bottlebrush squirreltail	5
				Fourwing saltbush	5
				Winterfat	5
Poley	Sandy Loam Upland, 10- to 14-inch precipitation zone	Favorable	1,000	Black grama	15
		Normal	700	Needleandthread	15
		Unfavorable	400	Indian ricegrass	15
				Blue grama	10
				Sand dropseed	10
				Galleta	10
				Bottlebrush squirreltail	5
				Fourwing saltbush	5
				Winterfat	5
22*:					
Kopie.					
Servilleta	Clay Loam Upland, 10- to 14-inch precipitation zone	Favorable	900	Blue grama	25
		Normal	700	Western wheatgrass	15
		Unfavorable	500	Galleta	10
				Fourwing saltbush	10
				Bottlebrush squirreltail	5
				Spike muhly	5
				Winterfat	5
				Needleandthread	5
				Sideoats grama	5
24*:					
Lomaki	Cinder Hills, 10- to 14-inch precipitation zone	Favorable	1,000	Black grama	25
		Normal	700	Blue grama	20
		Unfavorable	400	Galleta	10
				Needleandthread	10
				Sideoats grama	10
				Dropseed	10
				Threeawn	5
				Bottlebrush squirreltail	5
				Winterfat	5
Nalaki	Cinder Hills, 10- to 14-inch precipitation zone	Favorable	1,200	Black grama	25
		Normal	800	Blue grama	20
		Unfavorable	400	Galleta	10
				Needlegrass	10
				Dropseed	10
				Sideoats grama	10
				Fourwing saltbush	5
				Bottlebrush squirreltail	5
				Winterfat	5

See footnote at end of table.

TABLE 5.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
25*:					
Mespun	Sandy Upland, 10- to 14-inch precipitation zone	Favorable	1,000	Galleta	10
		Normal	700	Indian ricegrass	10
		Unfavorable	500	Needleandthread	10
				Blue grama	10
				Dropseed	10
				Mormon tea	10
				Bottlebrush squirreltail	5
				Black grama	5
				Spike muhly	5
				Fourwing saltbush	5
				Sand sagebrush	5
				Utah juniper	5
Palma	Sandy Loam Upland, 10- to 14-inch precipitation zone	Favorable	1,200	Blue grama	20
		Normal	750	Galleta	15
		Unfavorable	600	Needleandthread	15
				Dropseed	10
				Indian ricegrass	10
				Fourwing saltbush	5
				Mormon-tea	5
				Juniper	5
				Bottlebrush squirreltail	5
26 Navajo	Clay Bottom, 6- to 10-inch precipitation zone	Favorable	2,500	Alkali sacaton	35
		Normal	1,500	Blue grama	15
		Unfavorable	1,200	Fourwing saltbush	15
				Western wheatgrass	10
				Vine-mesquite	10
				Galleta	10
27 Palma	Sandy Loam Upland, 10- to 14-inch precipitation zone	Favorable	1,200	Blue grama	20
		Normal	750	Galleta	15
		Unfavorable	600	Needleandthread	15
				Dropseed	10
				Indian ricegrass	10
				Fourwing saltbush	5
				Mormon-tea	5
				Juniper	5
				Bottlebrush squirreltail	5
28 Pastura	Caliche Upland, 10- to 14-inch precipitation zone	Favorable	900	Black grama	25
		Normal	600	Blue grama	15
		Unfavorable	450	Sideoats grama	15
				Winterfat	10
				Needleandthread	10
				Galleta	5
				Dropseed	5
				Muttongrass	5
				Juniper	5
29*:					
Paymaster	Loamy Bottom, 10- to 14-inch precipitation zone	Favorable	1,300	Western wheatgrass	25
		Normal	900	Blue grama	20
		Unfavorable	700	Fourwing saltbush	15
				Spike muhly	5
				Winterfat	5
				Bottlebrush squirreltail	5
				Sideoats grama	5
				Vine-mesquite	5
				Sand dropseed	5

See footnote at end of table.

TABLE 5.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
29*:					
Lynx	Loamy Bottom, 10- to 14-inch precipitation zone	Favorable	1,700	Western wheatgrass	30
		Normal	1,400	Fourwing saltbush	15
		Unfavorable	1,100	Vine-mesquite	10
				Blue grama	10
				Spike muhly	5
				Sideoats grama	5
				Winterfat	5
				Bottlebrush squirreltail	5
				Muttongrass	5
30 Poley	Sandy Loam Upland, 10- to 14-inch precipitation zone	Favorable	1,000	Black grama	15
		Normal	700	Needleandthread	15
		Unfavorable	400	Indian ricegrass	15
				Blue grama	10
				Sand dropseed	10
				Galleta	10
				Bottlebrush squirreltail	5
				Fourwing saltbush	5
				Winterfat	5
31 Poley	Loamy Upland, 10- to 14-inch precipitation zone	Favorable	850	Blue grama	25
		Normal	650	Black grama	20
		Unfavorable	500	Galleta	10
				Indian ricegrass	10
				Needleandthread	5
				Bottlebrush squirreltail	5
				Sand dropseed	5
				Alkali sacaton	5
				Fourwing saltbush	5
				Winterfat	5
32*:					
Poley	Loamy Upland, 10- to 14-inch precipitation zone	Favorable	850	Blue grama	25
		Normal	650	Black grama	20
		Unfavorable	500	Galleta	10
				Indian ricegrass	10
				Needleandthread	5
				Bottlebrush squirreltail	5
				Sand dropseed	5
				Alkali sacaton	5
				Fourwing saltbush	5
				Winterfat	5
Lynx	Loamy Bottom, 10- to 14-inch precipitation zone	Favorable	1,700	Western wheatgrass	30
		Normal	1,400	Fourwing saltbush	15
		Unfavorable	1,100	Vine-mesquite	10
				Blue grama	10
				Spike muhly	5
				Sideoats grama	5
				Winterfat	5
				Bottlebrush squirreltail	5
				Muttongrass	5
33*:					
Poley	Loamy Upland, 10- to 14-inch precipitation zone	Favorable	850	Blue grama	25
		Normal	650	Black grama	20
		Unfavorable	500	Galleta	10
				Indian ricegrass	10
				Needleandthread	5
				Bottlebrush squirreltail	5
				Sand dropseed	5
				Alkali sacaton	5
				Fourwing saltbush	5
				Winterfat	5

See footnote at end of table.

TABLE 5.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
33*:					
Tusayan	Limy Upland, 10- to 14-inch precipitation zone	Favorable	900	Black grama	20
		Normal	600	Blue grama	15
		Unfavorable	350	Sideoats grama	15
				Needleandthread	10
				New Mexico feathergrass	10
				Bottlebrush squirreltail	5
				Indian ricegrass	5
				Galleta	5
				Fourwing saltbush	5
				Winterfat	5
34 Purgatory	Gyp Upland, 6- to 10-inch precipitation zone	Favorable	600	Galleta	25
		Normal	400	Gyp dropseed	20
		Unfavorable	200	Alkali sacaton	10
				Bigelow sagebrush	10
				Fourwing saltbush	10
				Black grama	5
				Indian ricegrass	5
				Mormon-tea	5
				Sand dropseed	5
				Shadscale	5
35 Quivera	Loamy Upland, 10- to 14-inch precipitation zone	Favorable	750	Blue grama	25
		Normal	600	Black grama	15
		Unfavorable	500	Hairy grama	10
				Galleta	10
				Wolftail	5
				Bottlebrush squirreltail	5
				Needleandthread	5
				Indian ricegrass	5
				Twinberry	5
				Fourwing saltbush	5
				Winterfat	5
37 Rune	Clay Bottom, 10- to 14-inch precipitation zone	Favorable	2,500	Alkali sacaton	25
		Normal	1,600	Blue grama	15
		Unfavorable	1,200	Western wheatgrass	10
				Fourwing saltbush	10
				Vine-mesquite	5
				Bottlebrush squirreltail	5
				Spike muhly	5
				Sideoats grama	5
				Muttongrass	5
				Twinberry	5
38*:					
Rune	Clay Bottom, 10- to 14-inch precipitation zone	Favorable	2,500	Alkali sacaton	25
		Normal	1,650	Blue grama	15
		Unfavorable	1,250	Western wheatgrass	10
				Fourwing saltbush	10
				Vine-mesquite	5
				Bottlebrush squirreltail	5
				Spike muhly	5
				Sideoats grama	5
				Muttongrass	5
				Twinberry	5

See footnote at end of table.

TABLE 5.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
38*:					
Disterheff	Clay Loam Upland, 10- to 14-inch precipitation zone	Favorable	1,000	Western wheatgrass	15
		Normal	650	Galleta	15
		Unfavorable	300	Sideoats grama	10
				Blue grama	10
				Black grama	10
				Needleandthread	5
				Muttongrass	5
				Winterfat	5
				Fourwing saltbush	5
				Utah juniper	5
				Oneseed juniper	5
39 Servilleta	Clay Loam Upland, 10- to 14-inch precipitation zone	Favorable	900	Blue grama	25
		Normal	700	Western wheatgrass	15
		Unfavorable	500	Galleta	10
				Fourwing saltbush	10
				Bottlebrush squirreltail	5
				Spike muhly	5
				Winterfat	5
				Needleandthread	5
				Sideoats grama	5
40*:					
Servilleta	Clay Loam Upland, 10- to 14-inch precipitation zone	Favorable	900	Blue grama	25
		Normal	700	Western wheatgrass	15
		Unfavorable	500	Galleta	10
				Fourwing saltbush	10
				Bottlebrush squirreltail	5
				Spike muhly	5
				Winterfat	5
				Needleandthread	5
				Sideoats grama	5
Tusayan	Limy Upland, 10- to 14-inch precipitation zone	Favorable	900	Black grama	20
		Normal	600	Blue grama	15
		Unfavorable	350	Sideoats grama	15
				Needleandthread	10
				New Mexico feathergrass	10
				Bottlebrush squirreltail	5
				Indian ricegrass	5
				Galleta	5
				Fourwing saltbush	5
				Winterfat	5
43 Springerville	Clay Upland, 10- to 14-inch precipitation zone	Favorable	400	Western wheatgrass	20
		Normal	325	Blue grama	15
		Unfavorable	250	Sideoats grama	15
				Vine-mesquite	10
				Muttongrass	10
				Utah juniper	5
				Spike muhly	5
				Pinyon	5
				Junegrass	5
				Bottlebrush squirreltail	5
				Fourwing saltbush	5

See footnote at end of table.

TABLE 5.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
44: Springerville	Clay Upland, 10- to 14-inch precipitation zone	Favorable	400	Westgrn wheatgrass	20
		Normal	325	Blue grama	15
		Unfavorable	250	Sideoats grama	15
				Vine-mesquite	10
				Muttongrass	10
				Utah juniper	5
				Spike muhly	5
				Pinyon	5
				Junegrass	5
				Bottlebrush squirreltail	5
				Fourwing saltbush	5
45*:					
Tajo	Clay Loam Upland, 10- to 14-inch precipitation zone	Favorable	1,100	Blue grama	20
		Normal	950	Sideoats grama	15
		Unfavorable	750	Black grama	10
				Galleta	10
				Fourwing saltbush	10
				Juniper	5
				Needleandthread	5
				Winterfat	5
				New Mexico feathergrass	5
				Western wheatgrass	5
Springerville	Clay Upland, 10- to 14-inch precipitation zone	Favorable	400	Western wheatgrass	20
		Normal	325	Blue grama	15
		Unfavorable	250	Sideoats grama	15
				Vine-mesquite	10
				Muttongrass	10
				Utah juniper	5
				Spike muhly	5
				Pinyon	5
				Junegrass	5
				Bottlebrush squirreltail	5
				Fourwing saltbush	5
46: Tenorio	Loamy Upland, 10- to 14-inch precipitation zone	Favorable	750	Blue grama	20
		Normal	600	Black grama	15
		Unfavorable	500	Hairy grama	10
				Galleta	10
				Wolftail	5
				Bottlebrush squirreltail	5
				Needleandthread	5
				Indian ricegrass	5
				Twinberry	5
				Fourwing saltbush	5
				Winterfat	5
				Sand dropseed	5
				Threeawn	5
50: Torrifluvents	Saline Bottom, 6- to 10-inch precipitation zone	Favorable	2,500	Alkali sacaton	30
		Normal	1,750	Fourwing saltbush	20
		Unfavorable	1,200	Mound saltbush	10
				Shadscale	10
				Blue grama	10
				Inland saltgrass	5
				Greasewood	5
				Western wheatgrass	5
				Bottlebrush squirreltail	5

See footnote at end of table.

TABLE 5.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
51: Tours	Clay Bottom, 6- to 10-inch precipitation zone	Favorable	3,500	Alkali sacaton	30
		Normal	2,500	Fourwing saltbush	15
		Unfavorable	1,500	Western wheatgrass	15
				Blue grama	10
				Galleta	10
				Vine-mesquite	10
				Sideoats grama	5
				Indian ricegrass	5
52*:					
Tours	Loamy Bottom, 6- to 10-inch precipitation zone	Favorable	2,000	Alkali sacaton	20
		Normal	1,600	Western wheatgrass	20
		Unfavorable	1,150	Blue grama	15
				Fourwing saltbush	15
				Indian ricegrass	10
				Vine-mesquite	10
				Sideoats grama	5
				Galleta	5
Ives	Loamy Bottom, 6- to 10-inch precipitation zone	Favorable	850	Blue grama	15
		Normal	650	Dropseed	15
		Unfavorable	350	Indian ricegrass	10
				Alkali sacaton	10
				Galleta	10
				Needleandthread	10
				Black grama	5
				Sideoats grama	5
				New Mexico feathergrass	5
				Mormon-tea	5
				Fourwing saltbush	5
				Winterfat	5
55*:					
Tusayan	Limy Upland, 10- to 14-inch precipitation zone	Favorable	900	Black grama	20
		Normal	600	Blue grama	15
		Unfavorable	350	Sideoats grama	15
				Needleandthread	10
				New Mexico feathergrass	10
				Bottlebrush squirreltail	5
				Indian ricegrass	5
				Galleta	5
				Fourwing saltbush	5
				Winterfat	5
Lynx	Loamy Bottom, 10- to 14-inch precipitation zone	Favorable	1,700	Western wheatgrass	30
		Normal	1,400	Fourwing saltbush	15
		Unfavorable	1,100	Vine-mesquite	10
				Blue grama	10
				Spike muhly	5
				Sideoats grama	5
				Winterfat	5
				Bottlebrush squirreltail	5
				Muttongrass	5
56: Tuweep	Limy Upland, 6- to 10-inch precipitation zone	Favorable	800	Black grama	20
		Normal	500	New Mexico feathergrass	15
		Unfavorable	250	Alkali sacaton	15
				Sideoats grama	10
				Needleandthread	10
				Galleta	5
				Bush muhly	5
				Bottlebrush squirreltail	5
				Winterfat	5
				Fourwing saltbush	5

See footnote at end of table.

TABLE 5.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
57: Valle	Loamy Upland, 14- to 18-inch precipitation zone	Favorable	900	Blue grama	30
		Normal	700	Galleta	20
		Unfavorable	550	Needleandthread	15
				Indian ricegrass	5
				Fourwing saltbush	5
				Winterfat	5
				Bottlebrush squirreltail	5
				Muttongrass	5
				Sideoats grama	5
				Dropseed	5
59*:					
Wilaha.					
Wukoki	Cinder Hills, 10- to 14-inch precipitation zone	Favorable	800	Black grama	25
		Normal	500	Blue grama	20
		Unfavorable	300	Galleta	10
				Needlegrass	10
				Dropseed	10
				Sideoats grama	10
				Fourwing saltbush	5
				Bottlebrush squirreltail	5
				Winterfat	5
60: Winona	Shallow Loamy, 10- to 14-inch precipitation zone	Favorable	950	Black grama	15
		Normal	700	Blue grama	15
		Unfavorable	500	Needleandthread	10
				Sideoats grama	10
				Bigelow sagebrush	10
				Galleta	5
				Dropseed	5
				Juniper	5
				Winterfat	5
				Fourwing saltbush	5
				Mormon-tea	5
				Mexican cliffrose	5
61: Winona	Shallow Loamy, 10- to 14-inch precipitation zone	Favorable	950	Black grama	15
		Normal	700	Blue grama	15
		Unfavorable	500	Needleandthread	10
				Sideoats grama	10
				Bigelow sagebrush	10
				Galleta	5
				Dropseed	5
				Juniper	5
				Winterfat	5
				Fourwing saltbush	5
				Mormon-tea	5
				Mexican cliffrose	5
62*:					
Winona	Shallow Loamy, 10- to 14-inch precipitation zone	Favorable	950	Black grama	15
		Normal	700	Blue grama	15
		Unfavorable	500	Needleandthread	10
				Sideoats grama	10
				Bigelow sagebrush	10
				Galleta	5
				Dropseed	5
				Juniper	5
				Winterfat	5
				Fourwing saltbush	5
				Mormon-tea	5
				Mexican cliffrose	5

See footnote at end of table.

TABLE 5.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
62*:					
Boysag	Shallow Loamy, 10- to 14-inch precipitation zone	Favorable	1,100	Blue grama	25
		Normal	750	Needleandthread	15
		Unfavorable	500	Fourwing saltbush	10
				Black grama	10
				Sand dropseed	5
				Sideoats grama	5
				Winterfat	5
				New Mexico feathergrass	5
				Bottlebrush squirreltail	5
				Indian ricegrass	5
63*:					
Winona	Shallow Loamy, 10- to 14-inch precipitation zone	Favorable	950	Black grama	15
		Normal	700	Blue grama	15
		Unfavorable	500	Needleandthread	10
				Sideoats grama	10
				Bigelow sagebrush	10
				Galleta	5
				Dropseed	5
				Juniper	5
				Winterfat	5
				Fourwing saltbush	5
				Mormon-tea	5
				Mexican cliffrose	5
Epikom	Sandstone Upland, 10- to 14-inch precipitation zone	Favorable	700	Galleta	20
		Normal	550	Black grama	15
		Unfavorable	300	Blue grama	10
				Needleandthread	10
				Alkali sacaton	10
				Sideoats grama	10
				Juniper	5
				Fourwing saltbush	5
				Bigelow sagebrush	5
				Mormon-tea	5
				Indian ricegrass	5
64*:					
Winona	Shallow Loamy, 10- to 14-inch precipitation zone	Favorable	950	Black grama	15
		Normal	700	Blue grama	15
		Unfavorable	500	Needleandthread	10
				Sideoats grama	10
				Bigelow sagebrush	10
				Galleta	5
				Dropseed	5
				Juniper	5
				Winterfat	5
				Fourwing saltbush	5
				Mormon-tea	5
				Mexican cliffrose	5
Rock outcrop.					

See footnote at end of table.

TABLE 5.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
65*:					
Winona	Breaks, 10- to 14-inch precipitation zone	Favorable	950	Black grama	15
		Normal	700	Blue grama	15
		Unfavorable	500	Needleandthread	10
				Sideoats grama	10
				Bigelow sagebrush	10
				Galleta	5
				Dropseed	5
				Juniper	5
				Winterfat	5
				Fourwing saltbush	5
				Mormon-tea	5
				Mexican cliffrose	5
Rock outcrop.					
66*:					
Winona	Shallow Loamy, 10- to 14-inch precipitation zone	Favorable	950	Black grama	15
		Normal	700	Blue grama	15
		Unfavorable	500	Needleandthread	10
				Sideoats grama	10
				Bigelow sagebrush	10
				Galleta	5
				Dropseed	5
				Juniper	5
				Winterfat	5
				Fourwing saltbush	5
				Mormon-tea	5
				Mexican cliffrose	5
Tusayan	Limy Upland, 10- to 14-inch precipitation zone	Favorable	900	Black grama	20
		Normal	600	Blue grama	15
		Unfavorable	350	Sideoats grama	15
				Needleandthread	10
				New Mexico feathergrass	10
				Bottlebrush squirreltail	5
				Indian ricegrass	5
				Galleta	5
				Fourwing saltbush	5
				Winterfat	5
67*:					
Wukoki	Cinder Hills, 10- to 14-inch precipitation zone	Favorable	800	Black grama	25
		Normal	500	Blue grama	20
		Unfavorable	300	Galleta	10
				Needlegrass	10
				Dropseed	10
				Sideoats grama	10
				Fourwing saltbush	5
				Bottlebrush squirreltail	5
				Winterfat	5
Rock outcrop.					
68*:					
Wukoki	Cinder Hills, 10- to 14-inch precipitation zone	Favorable	800	Black grama	25
		Normal	500	Blue grama	20
		Unfavorable	300	Galleta	10
				Needlegrass	10
				Dropseed	10
				Sideoats grama	10
				Fourwing saltbush	5
				Bottlebrush squirreltail	5
				Winterfat	5

See footnote at end of table.

TABLE 5.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
68*:					
Wupatki	Cinder Hills, 10- to 14-inch precipitation zone	Favorable	800	Black grama	25
		Normal	500	Sideoats grama	15
		Unfavorable	350	Galleta	15
				Blue grama	10
				Needleandthread	10
				Bottlebrush squirreltail	5
				Threeawn	5
				Winterfat	5
				Fourwing saltbush	5
				Mormon-tea	5
69*:					
Wupatki	Cinder Hills, 10- to 14-inch precipitation zone	Favorable	800	Black grama	25
		Normal	500	Sideoats grama	15
		Unfavorable	350	Galleta	15
				Blue grama	10
				Needleandthread	10
				Bottlebrush squirreltail	5
				Threeawn	5
				Winterfat	5
				Fourwing saltbush	5
				Mormon-tea	5
Wukoki	Cinder Hills, 10- to 14-inch precipitation zone	Favorable	800	Black grama	25
		Normal	500	Blue grama	20
		Unfavorable	300	Galleta	10
				Needlegrass	10
				Dropseed	10
				Sideoats grama	10
				Fourwing saltbush	5
				Bottlebrush squirreltail	5
				Winterfat	5
71*:					
Ziegler.					
Cross	Shallow Loamy, 10- to 14-inch precipitation zone	Favorable	800	Sideoats grama	20
		Normal	600	Blue grama	15
		Unfavorable	500	Galleta	15
				Black grama	10
				New Mexico feathergrass	10
				Oneseed juniper	10
				Bottlebrush squirreltail	5

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 6.--WOODLAND MANAGEMENT AND PRODUCTIVITY

[Only the soils suitable for production of commercial trees are listed. Absence of an entry indicates that information was not available]

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Management concerns: Equipment limitation	Management concerns: Seedling mortality	Management concerns: Plant competition	Potential productivity: Common trees	Potential productivity: Site
6*:							
Boquillas	3o	Slight	Slight	Slight	Slight	Utah juniper	33
						Pinyon	33
Seligman	2o	Slight	Slight	Moderate	Slight	Utah juniper	91
						Pinyon	91
9*:							
Daze.							
Deama	3r	Moderate	Slight	Slight	Slight	Pinyon	43
						Oneseed juniper	43
						Utah juniper	43
10 Deama	3o	Slight	Slight	Slight	Slight	Pinyon	43
						Oneseed juniper	43
						Utah juniper	43
11 Deama	3o	Slight	Moderate	Slight	Slight	Pinyon	43
						Oneseed juniper	43
						Utah juniper	43
12*:							
Deama	3x	Slight	Moderate	Slight	Slight	Oneseed juniper	43
						Utah juniper	43
						Pinyon	43
Rock outcrop.							
13*:							
Deama	3o	Slight	Slight	Slight	Slight	Pinyon	43
						Oneseed juniper	43
						Utah juniper	43
Toqui	3o	Moderate	Slight	Slight	Severe	Pinyon	40
						Utah juniper	40
						Oneseed juniper	40
22*:							
Kopie	3d	Moderate	Slight	Moderate	Moderate	Oneseed juniper	11
						Pinyon	11
Servilleta.							
41 Showlow	2c	Moderate	Slight	Slight	Slight	Utah juniper	60
						Oneseed juniper	60
						Pinyon	60
42*: Showlow	2c	Moderate	Moderate	Moderate	Slight	Utah juniper	60
						Oneseed juniper	60
						Pinyon	60
47*:							
Thunderbird	2x	Slight	Moderate	Moderate	Slight	Utah juniper	51
Cabezon	1x	Slight	Severe	Slight	Slight	Utah juniper	140
						Pinyon	140
48*:							
Thunderbird	2r	Moderate	Severe	Moderate	Slight	Utah juniper	51
Rock outcrop.							

See footnote at end of table.

TABLE 6.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Management concerns: Equipment limitation	Management concerns: Seedling mortality	Management concerns: Plant competition	Potential productivity: Common trees	Potential productivity: Site
49*:							
Thunderbird	2x	Slight	Moderate	Moderate	Slight	Utah juniper	51
Springville	3c	Slight	Moderate	Severe	Slight	Utah juniper	42
						Oneseed juniper	42
						Pinyon	42
53*:							
Tovar	3x	Slight	Severe	Slight	Moderate	Utah juniper	45
						Pinyon	17
Tovar	3c	Moderate	Severe	Slight	Moderate	Utah juniper	45
						Pinyon	17
54*:							
Tovar	3x	Slight	Severe	Moderate	Moderate	Utah juniper	45
						Pinyon	17
Tovar	3c	Slight	Severe	Moderate	Moderate	Utah juniper	45
						Pinyon	17
58 Wilaha	3o	Moderate	Moderate	Moderate	Slight	Pinyon	33
						Utah juniper	33
						Oneseed juniper	33
59*:							
Wilaha	3r	Moderate	Severe	Moderate	Slight	Pinyon	33
						Utah juniper	33
						Oneseed juniper	33
Wukoki.							
70 Ziegler	3c	Slight	Moderate	Moderate	Slight	Pinyon	48
						Oneseed juniper	48
						Utah juniper	48
71*:							
Ziegler	3c	Slight	Moderate	Moderate	Slight	Pinyon	48
						Oneseed juniper	48
						Utah juniper	48
Cross.							
72*:							
Ziegler	3c	Slight	Moderate	Moderate	Slight	Pinyon	48
						Oneseed juniper	48
						Utah juniper	48
Wilaha	3o	Moderate	Moderate	Moderate	Slight	Pinyon	33
						Utah juniper	33
						Oneseed juniper	33

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--WOODLAND UNDERSTORY VEGETATION

[Only the soils suitable for production of commercial trees are listed]

Soil name and map symbol	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
		Lb/acre		Pct
6*:				
Boquillas	Favorable	200	Blue grama	25
	Normal	150	Mexican cliffrose	10
	Unfavorable	100	Antelope bitterbrush	10
			Horehound	5
			Lupine	5
			Cactus	5
			Goldenweed	5
			Desertthorn	5
			Globemallow	5
			Pinyon ricegrass	5
Seligman	Favorable	175	Blue grama	25
	Normal	125	Sideoats grama	10
	Unfavorable	75	Pinyon ricegrass	5
			Threeawn	5
			Penstemon	5
			Skyrocket gilia	5
			Cactus	5
			Banana yucca	5
			Whipple cholla	5
			Desert ceanothus	5
			Antelope bitterbrush	5
			Mexican cliffrose	5
9*:				
Daze.				
Deama	Favorable	150	Blue grama	20
	Normal	100	Muttongrass	10
	Unfavorable	75	Bottlebrush squirreltail	5
			Threeawn	5
			Bladderpod	5
			Paperflower	5
			Bird's-beak	5
			Rubberweed	5
			Mexican cliffrose	5
			Algerita	5
			Broom snakeweed	5
			Needleandthread	5
10, 11 Deama	Favorable	150	Blue grama	20
	Normal	100	Muttongrass	10
	Unfavorable	75	Bottlebrush squirreltail	5
			Threeawn	5
			Bladderpod	5
			Paperflower	5
			Bird's-beak	5
			Rubberweed	5
			Mexican cliffrose	5
			Algerita	5
			Broom snakeweed	5
			Needleandthread	5
12*:				
Deama	Favorable	150	Blue grama	20
	Normal	100	Muttongrass	10
	Unfavorable	75	Bottlebrush squirreltail	5
			Threeawn	5
			Bladderpod	5
			Paperflower	5
			Bird's-beak	5
			Rubberweed	5
			Mexican cliffrose	5
			Algerita	5
			Broom snakeweed	5
			Needleandthread	5

See footnote at end of table.

TABLE 7.--WOODLAND UNDERSTORY VEGETATION--Continued

Soil name and map symbol	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
		Lb/acre		Pct
12*:				
Rock outcrop.				
13*:				
Deama	Favorable	150	Blue grama	20
	Normal	100	Muttongrass	10
	Unfavorable	75	Bottlebrush squirreltail	5
			Threeawn	5
			Bladderpod	5
			Paperflower	5
			Bird's-beak	5
			Rubberweed	5
			Mexican cliffrose	5
			Algerita	5
			Broom snakeweed	5
			Needleandthread	5
Toqui	Favorable	400	Blue grama	20
	Normal	250	Bottlebrush squirreltail	10
	Unfavorable	175	Big sagebrush	10
			Muttongrass	5
			Black grama	5
			Lupine	5
			Gilia	5
			Aster	5
			Fleabane	5
			Mexican cliffrose	5
			Yucca	5
			Fremont mahonia	5
			Broom snakeweed	5
22*:				
Kopie	Favorable	900	Black grama	15
	Normal	750	Indian ricegrass	10
	Unfavorable	600	New Mexico feathergrass	10
			Fourwing saltbush	10
			Blue grama	5
			Bottlebrush squirreltail	5
			Fremont mahonia	5
			Four-o'clock	5
			Aster	5
			Broom snakeweed	5
			Wolfberry	5
Servilleta.				
41, 42*: Showlow	Favorable	350	Blue grama	15
	Normal	250	Turbinella oak	10
	Unfavorable	175	Bottlebrush squirreltail	5
			Sideoats grama	5
			Prairie junegrass	5
			Threeawn	5
			Cactus	5
			Broom snakeweed	5
			Pinyon ricegrass	5
			Scurfpea	5
47*:				
Thunderbird	Favorable	250	Sideoats grama	20
	Normal	200	Blue grama	10
	Unfavorable	150	Muttongrass	10
			Threeawn	5
			Pinyon ricegrass	5
			Apacheplume	5
			Cactus	5
			Banana yucca	5
			Stansbury cliffrose	5
			Spurge	5
			Lupine	5

See footnote at end of table.

TABLE 7.--WOODLAND UNDERSTORY VEGETATION--Continued

Soil name and map symbol	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
		Lb/acre		Pct
47*:				
Cabezon	Favorable	200	Sideoats grama	15
	Normal	150	Blue grama	15
	Unfavorable	100	Threeawn	5
			Prairie junegrass	5
			Muttongrass	5
			Claretcup cactus	5
			Banana yucca	5
			Mexican cliffrose	5
			Scarfpea	5
			Pricklepear	5
			Deervetch	5
			Antelope bitterbrush	5
48*:				
Thunderbird	Favorable	250	Sideoats grama	20
	Normal	200	Blue grama	10
	Unfavorable	150	Muttongrass	10
			Threeawn	5
			Pinyon ricegrass	5
			Apacheplume	5
			Cactus	5
			Banana yucca	5
			Stansbury cliffrose	5
			Spurge	5
			Lupine	5
Rock outcrop.				
49*:				
Thunderbird	Favorable	250	Sideoats grama	20
	Normal	200	Blue grama	10
	Unfavorable	150	Muttongrass	10
			Threeawn	5
			Pinyon ricegrass	5
			Apacheplume	5
			Cactus	5
			Banana yucca	5
			Stansbury cliffrose	5
			Spurge	5
			Lupine	5
Springerville	Favorable	400	Blue grama	15
	Normal	325	Sideoats grama	10
	Unfavorable	250	Claretcup cactus	10
			Pinyon ricegrass	5
			Threeawn	5
			Skunkbush sumac	5
			Cactus	5
			Buckwheat	5
			Lupine	5
			Broom snakeweed	5
53*, 54*:				
Tovar	Favorable	1,000	Blue grama	10
	Normal	600	Needleandthread	10
	Unfavorable	400	Sideoats grama	10
			Turbinella oak	10
			Galleta	5
			Littleseed ricegrass	5
			Muttongrass	5
			Bottlebrush squirreltail	5
			Birchleaf mountainmahogany	5
			Fourwing saltbush	5
			Winterfat	5

See footnote at end of table.

TABLE 7.--WOODLAND UNDERSTORY VEGETATION--Continued

Soil name and map symbol	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
		Lb/acre		Pct
58-----------------	Favorable	475	Blue grama	20
Wilaha	Normal	300	Muttongrass	10
	Unfavorable	200	Bottlebrush squirreltail	5
			Threeawn	5
			Skunkbush sumac	5
			Desertthorn	5
			Mexican cliffrose	5
			Goldeneye	5
			Locoweed	5
			Penstemon	5
			Fremont mahonia	5
59*:				
Wilaha------------	Favorable	475	Blue grama	20
	Normal	300	Muttongrass	10
	Unfavorable	200	Bottlebrush squirreltail	5
			Threeawn	5
			Skunkbush sumac	5
			Desertthorn	5
			Mexican cliffrose	5
			Goldeneye	5
			Locoweed	5
			Penstemon	5
			Fremont mahonia	5
Wukoki.				
70-----------------	Favorable	200	Blue grama	20
Ziegler	Normal	150	Threeawn	10
	Unfavorable	125	Sideoats grama	10
			Bottlebrush squirreltail	5
			Skunkbush sumac	5
			Fremont mahonia	5
			Bitterbrush	5
			Buckwheat	5
			Lupine	5
			Pingue	5
			Goldeneye	5
			Globemallo	5
71*:				
Ziegler-----------	Favorable	200	Blue grama	20
	Normal	150	Threeawn	10
	Unfavorable	125	Sideoats grama	10
			Bottlebrush squirreltail	5
			Skunkbush sumac	5
			Fremont mahonia	5
			Bitterbrush	5
			Buckwheat	5
			Lupine	5
			Pingue	5
			Goldeneye	5
			Globemallow	5
Cross.				
72*:				
Ziegler-----------	Favorable	200	Blue grama	20
	Normal	150	Threeawn	10
	Unfavorable	125	Sideoats grama	10
			Bottlebrush squirreltail	5
			Skunkbush sumac	5
			Fremont mahonia	5
			Bitterbrush	5
			Buckwheat	5
			Lupine	5
			Pingue	5
			Goldeneye	5
			Globemallow	5

See footnote at end of table.

TABLE 7.--WOODLAND UNDERSTORY VEGETATION--Continued

Soil name and map symbol	Total production		Characteristic vegetation	Composition
	Kind of year	Dry weight		
		Lb/acre		Pct
72*:				
Wilaha	Favorable	475	Blue grama	20
	Normal	300	Muttongrass	10
	Unfavorable	200	Bottlebrush squirreltail	5
			Threeawn	5
			Skunkbush sumac	5
			Desertthorn	5
			Mexican cliffrose	5
			Goldeneye	5
			Locoweed	5
			Penstemon	5
			Fremont mahonia	5

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--RECREATIONAL DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
1 Ashfork	Moderate: slope, small stones.	Moderate: slope, small stones.	Severe: slope, small stones.	Slight	Moderate: small stones, slope, thin layer.
2 Aut	Moderate: small stones, dusty.	Moderate: small stones, dusty.	Severe: small stones.	Moderate: dusty.	Moderate: small stones, thin layer.
3*:					
Aut	Moderate: small stones, dusty.	Moderate: small stones, dusty.	Severe: small stones.	Moderate: dusty.	Moderate: small stones, thin layer.
Cross	Severe: depth to rock.	Severe: depth to rock.	Severe: large stones, slope, depth to rock.	Severe: large stones.	Severe: large stones, droughty, thin layer.
4*:					
Aut	Moderate: small stones, dusty.	Moderate: small stones, dusty.	Severe: small stones.	Moderate: dusty.	Moderate: small stones, thin layer.
Lynx	Severe: flooding.	Slight	Moderate: slope.	Slight	Slight.
5*:					
Badland.					
Torriorthents.					
6*:					
Boquillas	Moderate: slope, small stones, dusty.	Moderate: slope, small stones, dusty.	Severe: slope, small stones.	Moderate: dusty.	Moderate: small stones, large stones, slope.
Seligman	Severe: small stones, depth to rock.	Severe: small stones, depth to rock.	Severe: slope, small stones, depth to rock.	Slight	Severe: small stones, thin layer.
7 Clovis	Slight	Slight	Moderate: slope.	Slight	Slight.
8*:					
Cross	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, small stones, depth to rock.	Slight	Severe: thin layer.
Apache	Severe: depth to rock.	Severe: depth to rock.	Severe: large stones, slope, depth to rock.	Moderate: large stones.	Severe: large stones, thin layer.
9*:					
Daze	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, small stones, depth to rock.	Moderate: slope.	Severe: droughty, slope, thin layer.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
9*:					
Deama	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, small stones, depth to rock.	Moderate: slope.	Severe: slope, thin layer.
10 Deama	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, small stones, depth to rock.	Slight	Severe: thin layer.
11 Deama	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, small stones.	Moderate: large stones.	Severe: large stones, thin layer.
12*:					
Deama	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, small stones.	Moderate: large stones, slope.	Severe: large stones, slope, thin layer.
Rock outcrop.					
13*:					
Deama	Severe: depth to rock.	Severe: depth to rock.	Severe: small stones, depth to rock.	Slight	Severe: thin layer.
Toqui	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight	Severe: thin layer.
14*:					
Deama	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, small stones, depth to rock.	Severe: slope.	Severe: large stones, slope, thin layer.
Tovar	Severe: slope.	Severe: slope.	Severe: large stones, slope.	Severe: large stones, slope.	Severe: large stones, slope.
15. Disterheff	Severe: small stones.	Severe: small stones.	Severe: small stones, slope.	Severe: small stones.	Severe: small stones.
16*:					
Disterheff	Moderate: large stones.	Severe: large stones.	Severe: large stones, slope.	Moderate: large stones.	Severe: large stones.
Kopie	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, small stones, depth to rock.	Slight	Severe: thin layer.
17 Epikom	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: small stones.	Severe: small stones, droughty, thin layer.
18*:					
Epikom	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight	Severe: droughty, thin layer.
Epikom	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock, slope.	Slight	Severe: droughty, thin layer.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
19*:					
Epikom	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Slight	Severe: droughty, thin layer.
Rock outcrop.					
20*:					
Faraway	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, small stones, depth to rock.	Severe: slope.	Severe: slope, thin layer.
Rock outcrop.					
21*:					
Keeseha	Moderate: small stones.	Moderate: small stones.	Severe: small stones.	Slight	Moderate: small stones, droughty.
Poley	Moderate: small stones.	Moderate: small stones.	Severe: small stones.	Slight	Moderate: small stones.
22*:					
Kopie	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, small stones, depth to rock.	Slight	Severe: droughty, thin layer.
Servilleta	Slight	Slight	Moderate: slope, depth to rock.	Severe: erodes easily.	Moderate: thin layer.
23*. Lava flows					
24*:					
Lomaki	Severe: small stones.	Severe: small stones.	Severe: small stones.	Severe: small stones.	Severe: small stones, droughty.
Nalaki	Severe: small stones.	Severe: small stones.	Severe: small stones.	Severe: small stones.	Severe: small stones, droughty.
25*:					
Mespun	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Moderate: droughty, too sandy.
Palma	Slight	Slight	Moderate: slope.	Slight	Slight.
26 Navajo	Severe: flooding.	Moderate: too clayey, percs slowly.	Severe: too clayey, percs slowly.	Severe: too clayey.	Severe: too clayey.
27 Palma	Slight	Slight	Moderate: slope.	Slight	Slight.
28 Pastura	Severe: cemented pan.	Severe: cemented pan.	Severe: cemented pan.	Slight	Severe: droughty, thin layer.
29*:					
Paymaster	Severe: flooding.	Slight	Moderate: slope.	Slight	Slight.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
29*:					
Lynx	Severe: flooding.	Slight	Moderate: slope.	Slight	Slight.
30 Poley	Slight	Slight	Moderate: slope.	Slight	Slight.
31 Poley	Moderate: small stones.	Moderate: small stones.	Severe: small stones.	Slight	Moderate: small stones.
32*:					
Poley	Moderate: small stones.	Moderate: small stones.	Severe: small stones.	Slight	Moderate: small stones.
Lynx	Severe: flooding.	Slight	Moderate: slope.	Slight	Slight.
33*:					
Poley	Moderate: small stones.	Moderate: small stones.	Severe: small stones.	Slight	Moderate: small stones.
Tusayan	Moderate: small stones, dusty.	Moderate: small stones, dusty.	Severe: small stones.	Moderate: dusty.	Moderate: small stones, droughty, thin layer.
34 Purgatory	Moderate: small stones.	Moderate: small stones.	Severe: small stones.	Slight	Moderate: small stones, thin layer.
35 Quivera	Severe: small stones.	Severe: small stones.	Severe: small stones.	Severe: small stones.	Severe: small stones.
36*. Riverwash					
37 Rune	Severe: flooding.	Slight	Moderate: slope.	Slight	Slight.
38*:					
Rune	Severe: flooding.	Slight	Slight	Slight	Slight.
Disterheff	Moderate: large stones.	Moderate: large stones.	Severe: large stones.	Moderate: large stones.	Moderate: large stones.
39 Servilleta	Slight	Slight	Moderate: slope, depth to rock.	Severe: erodes easily.	Moderate: thin layer.
40*:					
Servilleta	Slight	Slight	Moderate: slope, depth to rock.	Severe: erodes easily.	Moderate: thin layer.
Tusayan	Moderate: small stones, dusty.	Moderate: small stones, dusty.	Severe: small stones.	Moderate: dusty.	Moderate: small stones, droughty, thin layer.
41 Showlow	Moderate: small stones.	Moderate: small stones.	Severe: small stones.	Slight	Moderate: small stones.
42* Showlow	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Moderate: slope.	Severe: slope.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
43 Springerville	Moderate: large stones.	Moderate: large stones.	Severe: large stones, too clayey.	Moderate: large stones.	Severe: large stones, too clayey.
44 Springerville	Moderate: large stones.	Moderate: large stones.	Severe: large stones, too clayey.	Severe: large stones.	Severe: large stones, too clayey.
45*:					
Tajo	Moderate: small stones, slope.	Moderate: slope, small stones.	Severe: slope, small stones.	Slight	Moderate: small stones, slope, thin layer.
Springerville	Moderate: large stones.	Moderate: large stones.	Severe: large stones, too clayey.	Moderate: large stones.	Severe: large stones, too clayey.
46 Tenorio	Severe: small stones.	Severe: small stones.	Severe: small stones.	Slight	Severe: small stones.
47*:					
Thunderbird	Severe: slope, large stones.	Severe: slope, large stones.	Severe: large stones, slope.	Severe: large stones.	Severe: large stones, slope.
Cabezon	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Moderate: large stones, slope.	Severe: large stones, slope, thin layer.
48*:					
Thunderbird	Severe: slope, large stones.	Severe: slope, large stones.	Severe: large stones, slope.	Severe: large stones, slope.	Severe: large stones, slope.
Rock outcrop.					
49*:					
Thunderbird	Severe: slope.	Severe: slope.	Severe: large stones, slope.	Severe: large stones, slope.	Severe: large stones, slope.
Springerville	Moderate: large stones.	Moderate: large stones.	Severe: large stones, too clayey.	Moderate: large stones.	Severe: large stones, too clayey.
50*. Torrifluvents					
51 Tours	Severe: flooding.	Slight	Moderate: slope.	Severe: erodes easily.	Slight.
52*:					
Tours	Severe: flooding.	Slight	Moderate: slope.	Slight	Slight.
Ives	Severe: flooding.	Slight	Moderate: slope.	Slight	Slight.
53*:					
Tovar	Severe: slope.	Severe: slope.	Severe: slope, large stones.	Severe: large stones.	Severe: large stones, slope.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
53*:					
Tovar	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
54*:					
Tovar	Severe: slope, large stones.	Severe: slope, large stones.	Severe: large stones, slope.	Severe: large stones, slope.	Severe: large stones, slope.
Tovar	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
55*:					
Tusayan	Moderate: small stones, dusty.	Moderate: small stones, dusty.	Severe: small stones.	Moderate: dusty.	Moderate: small stones, droughty, thin layer.
Lynx	Severe: flooding.	Slight	Moderate: slope.	Slight	Slight.
56 Tuweep	Severe: small stones.	Severe: small stones.	Severe: slope, small stones.	Severe: small stones.	Severe: small stones.
57 Valle	Moderate: small stones, dusty.	Moderate: small stones, dusty.	Severe: small stones, dusty.	Moderate: dusty.	Moderate: small stones.
58 Wilaha	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Severe: slope.	Severe: slope.
59*:					
Wilaha	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Severe: slope.	Severe: slope.
Wukoki	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope, small stones.	Severe: small stones, slope.
60 Winona	Severe: depth to rock.	Severe: depth to rock.	Severe: small stones, depth to rock.	Moderate: dusty.	Severe: droughty, thin layer.
61 Winona	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Moderate: large stones, dusty.	Severe: large stones, droughty, thin layer.
62*:					
Winona	Severe: depth to rock.	Severe: depth to rock.	Severe: small stones, depth to rock.	Moderate: dusty.	Severe: droughty, thin layer.
Boysag	Severe: depth to rock.	Severe: depth to rock.	Severe: small stones, depth to rock.	Moderate: dusty.	Severe: droughty, thin layer.
63*:					
Winona	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Moderate: large stones, dusty.	Severe: large stones, droughty, thin layer.
Epikom	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight	Severe: droughty, thin layer.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
64*:					
Winona	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, small stones, depth to rock.	Moderate: slope, dusty.	Severe: slope, droughty, thin layer.
Rock outcrop.					
65*:					
Winona	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, small stones, depth to rock.	Severe: slope.	Severe: slope, droughty, thin layer.
Rock outcrop.					
66*:					
Winona	Severe: depth to rock.	Severe: depth to rock.	Severe: small stones, depth to rock.	Slight	Severe: droughty, thin layer.
Tusayan	Moderate: small stones.	Moderate: small stones.	Severe: small stones.	Slight	Moderate: small stones, droughty, thin layer.
67*:					
Wukoki	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope, small stones.	Severe: small stones.	Severe: small stones, slope.
Rock outcrop.					
68*:					
Wukoki	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope.	Severe: small stones, slope.
Wupatki	Severe: slope, small stones, cemented pan.	Severe: slope, small stones, cemented pan.	Severe: slope, small stones, cemented pan.	Severe: slope.	Severe: small stones, droughty, slope.
69*:					
Wupatki	Severe: small stones, cemented pan.	Severe: small stones, cemented pan.	Severe: slope, small stones, cemented pan.	Moderate: dusty.	Severe: small stones, droughty, thin layer.
Wukoki	Severe: small stones.	Severe: small stones.	Severe: slope, small stones.	Moderate: dusty.	Severe: small stones.
70 Ziegler	Moderate: small stones.	Moderate: small stones.	Severe: small stones.	Slight	Moderate: small stones.
71*:					
Ziegler	Moderate: small stones.	Moderate: small stones.	Severe: small stones.	Slight	Moderate: small stones.
Cross	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Moderate: large stones.	Severe: large stones, droughty, thin layer.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
72*:					
Ziegler	Moderate: slope, small stones.	Moderate: slope, small stones.	Severe: slope, small stones.	Slight	Moderate: small stones.
Wilaha	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Moderate: slope.	Severe: slope.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--WILDLIFE HABITAT POTENTIALS

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
1-----Ashfork	Poor	Poor	Fair	---	---	Fair	Poor	Very poor.	Poor	---	Very poor.	Fair.
2-----Aut	Poor	Poor	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
3*:												
Aut-----	Poor	Poor	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
Cross-----	Poor	Poor	Fair	---	---	Fair	Poor	Very poor.	Poor	---	Very poor.	Fair.
4*:												
Aut-----	Poor	Poor	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
Lynx-----	Poor	Poor	Good	---	---	Good	Very poor.	Very poor.	Poor	---	Very poor.	Good.
5*:												
Badland.												
Torriorthents.												
6*:												
Boquillas-----	Poor	Poor	Fair	---	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.	Fair.
Seligman-----	Poor	Poor	Fair	---	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.	Fair.
7-----Clovis	Poor	Poor	Fair	---	---	Fair	Poor	Very poor.	Poor	---	Very poor.	Fair.
8*:												
Cross-----	Poor	Poor	Fair	---	---	Fair	Poor	Very poor.	Poor	---	Very poor.	Fair.
Apache-----	Very poor.	Very poor.	Fair	---	---	Fair	Very poor.	Very poor.	Very poor.	---	Very poor.	Fair.
9*:												
Daze-----	Poor	Poor	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
Deama-----	Poor	Poor	Fair	---	Fair	Poor	Very poor.	Very poor.	Poor	Fair	Very poor.	Fair.
10, 11-----Deama	Poor	Poor	Fair	---	Fair	Poor	Very poor.	Very poor.	Poor	Fair	Very poor.	Fair.
12*:												
Deama-----	Poor	Poor	Fair	---	Fair	Poor	Very poor.	Very poor.	Poor	Fair	Very poor.	Fair.
Rock outcrop.												
13*:												
Deama-----	Poor	Poor	Fair	---	Fair	Poor	Very poor.	Very poor.	Poor	Fair	Very poor.	Fair.

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
13*:												
Toqui	Poor	Poor	Fair	---	Fair	Good	Very poor.	Very poor.	Poor	Good	Very poor.	Fair.
14*:												
Deama	Very poor.	Very poor.	Fair	---	Fair	Poor	Very poor.	Very poor.	Very poor.	Fair	Very poor.	Fair.
Tovar	Very poor.	Very poor.	Fair	---	Good	Fair	Very poor.	Very poor.	Very poor.	Good	Very poor.	Fair.
15 Disterheff	Poor	Poor	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
16*:												
Disterheff	Poor	Fair	Fair	---	---	Fair	Poor	Very poor.	Fair	---	Very poor.	Fair.
Kopie	Poor	Poor	Fair	---	Fair	Good	Very poor.	Very poor.	Poor	Fair	Poor	Fair.
17 Epikom	Very poor.	Very poor.	Fair	---	---	Fair	Very poor.	Very poor.	Very poor.	---	Very poor.	Poor.
18*:												
Epikom	Very poor.	Very poor.	Fair	---	---	Fair	Very poor.	Very poor.	Very poor.	---	Very poor.	Poor.
Epikom	Very poor.	Very poor.	Fair	---	---	Fair	Very poor.	Very poor.	Very poor.	---	Very poor.	Poor.
19*:												
Epikom	Very poor.	Very poor.	Fair	---	---	Fair	Very poor.	Very poor.	Very poor.	---	Very poor.	Poor.
Rock outcrop.												
20*:												
Faraway	Very poor.	Very poor.	Fair	Poor	---	Fair	Very poor.	Very poor.	Very poor.	Fair	Very poor.	Fair.
Rock outcrop.												
21*:												
Keeseha	Poor	Poor	Fair	---	---	Fair	Poor	Very poor.	Poor	---	Poor	Fair.
Poley	Poor	Poor	Good	---	---	Good	Poor	Very poor.	Fair	---	Very poor.	Good.
22*:												
Kopie	Poor	Poor	Fair	---	Fair	Good	Very poor.	Very poor.	Poor	Fair	Poor	Fair.
Servilleta	Very poor.	Very poor.	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
23*. Lava flows												
24*:												
Lomaki	Poor	Poor	Poor	---	---	Poor	Very poor.	Very poor.	Poor	---	Very poor.	Poor.
Nalaki	Poor	Poor	Poor	---	---	Poor	Very poor.	Poor	Poor	---	Very poor.	Poor.

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
25*:												
Mespun------------	Poor	Poor	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
Palma-------------	Poor	Poor	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
26---------------- Navajo	Very poor.	Very poor.	Fair	---	---	Poor	Very poor.	Very poor.	Very poor.	---	Very poor.	Fair.
27---------------- Palma	Poor	Poor	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
28---------------- Pastura	Poor	Poor	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
29*:												
Paymaster---------	Fair	Fair	Good	---	---	Good	Poor	Very poor.	Good	---	Very poor.	Fair.
Lynx--------------	Poor	Poor	Good	---	---	Good	Very poor.	Very poor.	Poor	---	Very poor.	Good.
30, 31------------ Poley	Poor	Poor	Good	---	---	Good	Poor	Very poor.	Fair	---	Very poor.	Good.
32*:												
Poley-------------	Poor	Poor	Good	---	---	Good	Poor	Very poor.	Fair	---	Very poor.	Good.
Lynx--------------	Poor	Poor	Good	---	---	Good	Very poor.	Very poor.	Poor	---	Very poor.	Good.
33*:												
Poley-------------	Poor	Poor	Good	---	---	Good	Poor	Very poor.	Fair	---	Very poor.	Good.
Tusayan-----------	Poor	Poor	Fair	---	---	Poor	Poor	Very poor.	Poor	---	Very poor.	Poor.
34---------------- Purgatory	Very poor.	Very poor.	Fair	---	---	Fair	Very poor.	Very poor.	Very poor.	---	Very poor.	Poor.
35---------------- Quivera	Poor	Poor	Fair	---	---	Fair	Very poor.	Very poor.	Very poor.	---	Very poor.	Fair.
36*. Riverwash												
37---------------- Rune	Poor	Poor	Fair	---	---	Fair	Poor	Very poor.	Very poor.	---	Very poor.	Fair.
38*:												
Rune--------------	Poor	Poor	Fair	---	---	Fair	Poor	Very poor.	Very poor.	---	Very poor.	Fair.
Disterheff--------	Poor	Fair	Fair	---	---	Fair	Poor	Very poor.	Fair	---	Very poor.	Fair.
39---------------- Servilleta	Very poor.	Very poor.	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
40*:												
Servilleta--------	Very poor.	Very poor.	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Hard- wood trees	Conif- erous plants	Shrubs	Wetland plants	Shallow water areas	Open- land wild- life	Wood- land wild- life	Wetland wild- life	Range- land wild- life
40*:												
Tusayan	Poor	Poor	Fair	---	---	Poor	Poor	Very poor.	Poor	---	Very poor.	Poor.
41 Showlow	Good	Good	Good	---	Good	Good	Poor	Poor	Good	Good	Poor	Good.
42* Showlow	Poor	Good	Good	---	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.	Good.
43, 44 Springerville	Poor	Poor	Good	---	---	Good	Poor	Very poor.	Poor	---	Very poor.	Good.
45*:												
Tajo	Very poor.	Very poor.	Fair	---	---	Fair	Very poor.	Very poor.	Very poor.	---	Very poor.	Fair.
Springerville	Poor	Poor	Good	---	---	Good	Poor	Very poor.	Poor	---	Very poor.	Good.
46 Tenorio	Poor	Poor	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
47*:												
Thunderbird	Poor	Poor	Fair	---	Good	Fair	Very poor.	Very poor.	Poor	Good	Very poor.	Fair.
Cabezon	Very poor.	Very poor.	Fair	---	Good	Fair	Very poor.	Very poor.	Poor	Good	Very poor.	Fair.
48*:												
Thunderbird	Very poor.	Very poor.	Fair	---	Good	Fair	Very poor.	Very poor.	Very poor.	Good	Very poor.	Fair.
Rock outcrop.												
49*:												
Thunderbird	Poor	Poor	Fair	---	Good	Fair	Very poor.	Very poor.	Poor	Good	Very poor.	Fair.
Springerville	Poor	Poor	Good	---	Good	Good	Poor	Very poor.	Poor	Good	Very poor.	Good.
50*. Torrifluvents												
51 Tours	Very poor.	Very poor.	Poor	---	---	Poor	Good	Very poor.	Very poor.	---	Poor	Poor.
52*:												
Tours	Very poor.	Very poor.	Poor	---	---	Poor	Good	Very poor.	Very poor.	---	Poor	Poor.
Ives	Very poor.	Very poor.	Fair	---	---	Fair	Poor	Very poor.	Very poor.	---	Very poor.	Poor.
53*:												
Tovar	Poor	Poor	Fair	---	Good	Fair	Very poor.	Very poor.	Poor	Good	Very poor.	Fair.
Tovar	Poor	Poor	Fair	---	Good	Fair	Very poor.	Very poor.	Poor	Good	Very poor.	Fair.
54*:												
Tovar	Very poor.	Very poor.	Fair	---	Good	Fair	Very poor.	Very poor.	Very poor.	Good	Very poor.	Fair.

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
54*:												
Tovar	Very poor.	Very poor.	Fair	---	Good	Fair	Very poor.	Very poor.	Very poor.	Good	Very poor.	Fair.
55*:												
Tusayan	Poor	Poor	Fair	---	---	Poor	Poor	Very poor.	Poor	---	Very poor.	Poor.
Lynx	Poor	Poor	Good	---	---	Good	Very poor.	Very poor.	Poor	---	Very poor.	Good.
56 Tuweep	Poor	Poor	Poor	---	---	Poor	Very poor.	Very poor.	Very poor.	---	Very poor.	Poor.
57 Valle	Fair	Fair	Fair	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
58 Wilaha	Poor	Poor	Fair	---	Good	Fair	Very poor.	Very poor.	Poor	Good	Very poor.	Fair.
59*:												
Wilaha	Very poor.	Very poor.	Fair	---	Good	Fair	Very poor.	Very poor.	Very poor.	Good	Very poor.	Fair.
Wukoki	Very poor.	Very poor.	Poor	---	---	Poor	Very poor.	Very poor.	Very poor.	---	Very poor.	Poor.
60, 61 Winona	Poor	Poor	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
62*:												
Winona	Poor	Poor	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
Boysag	Poor	Poor	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
63*:												
Winona	Poor	Poor	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
Epikom	Very poor.	Very poor.	Fair	---	---	Fair	Very poor.	Very poor.	Very poor.	---	Very poor.	Poor.
64*, 65*:												
Winona	Poor	Poor	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
Rock outcrop.												
66*:												
Winona	Poor	Poor	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
Tusayan	Poor	Poor	Fair	---	---	Poor	Poor	Very poor.	Poor	---	Very poor.	Poor.
67*:												
Wukoki	Poor	Poor	Poor	---	---	Poor	Very poor.	Very poor.	Poor	---	Very poor.	Poor.
Rock outcrop.												
68*:												
Wukoki	Very poor.	Very poor.	Poor	---	---	Poor	Very poor.	Very poor.	Very poor.	---	Very poor.	Poor.

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
68*:												
Wupatki	Very poor.	Very poor.	Poor	---	---	Poor	Very poor.	Very poor.	Very poor.	---	Very poor.	Poor.
69*:												
Wupatki	Poor	Poor	Poor	---	---	Poor	Very poor.	Very poor.	Poor	---	Very poor.	Poor.
Wukoki	Poor	Poor	Poor	---	---	Poor	Very poor.	Very poor.	Poor	---	Very poor.	Poor.
70 Ziegler	Poor	Poor	Fair	---	Good	Fair	Very poor.	Very poor.	Poor	Good	Very poor.	Fair.
71*:												
Ziegler	Poor	Poor	Fair	---	Good	Fair	Very poor.	Very poor.	Poor	Good	Very poor.	Fair.
Cross	Poor	Poor	Fair	---	---	Fair	Poor	Very poor.	Poor	---	Very poor.	Fair.
72*:												
Ziegler	Poor	Poor	Fair	---	Good	Fair	Very poor.	Very poor.	Poor	Good	Very poor.	Fair.
Wilaha	Poor	Poor	Fair	---	Good	Fair	Very poor.	Very poor.	Poor	Good	Very poor.	Fair.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
1 Ashfork	Severe: depth to rock.	Moderate: slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Moderate: depth to rock, slope, frost action.	Moderate: small stones, slope, thin layer.
2 Aut	Severe: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: slope, depth to rock.	Moderate: depth to rock, frost action.	Moderate: small stones, thin layer.
3*:						
Aut	Severe: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: slope, depth to rock.	Moderate: depth to rock, frost action.	Moderate: small stones, thin layer.
Cross	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock, low strength.	Severe: large stones, droughty, thin layer.
4*:						
Aut	Severe: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: slope, depth to rock.	Moderate: depth to rock, frost action.	Moderate: small stones, thin layer.
Lynx	Slight	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength.	Slight.
5*:						
Badland.						
Torriorthents.						
6*:						
Boquillas	Moderate: depth to rock, too clayey, slope.	Moderate: shrink-swell, slope.	Moderate: depth to rock, slope, shrink-swell.	Severe: slope.	Moderate: slope, shrink-swell.	Moderate: small stones, large stones, slope.
Seligman	Severe: depth to rock.	Severe: shrink-swell.	Severe: depth to rock, slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, shrink-swell.	Severe: small stones, thin layer.
7 Clovis	Slight	Moderate: shrink-swell.	Slight	Moderate: shrink-swell, slope.	Moderate: low strength, shrink-swell.	Slight.
8*:						
Cross	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock, low strength.	Severe: droughty, thin layer.
Apache	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Severe: large stones, droughty, thin layer.
9*:						
Daze	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, low strength, slope.	Severe: droughty, slope, thin layer.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
9*:						
Deama	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: droughty, slope, thin layer.
10 Deama	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Severe: droughty, thin layer.
11 Deama	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: slope, depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: large stones, droughty, thin layer.
12*:						
Deama	Severe: depth to rock, large stones, slope.	Severe: slope, depth to rock, large stones.	Severe: depth to rock, slope, large stones.	Severe: slope, depth to rock, large stones.	Severe: depth to rock, slope, large stones.	Severe: large stones, droughty, slope.
Rock outcrop.						
13*:						
Deama	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: droughty, thin layer.
Toqui	Severe: depth to rock.	Severe: shrink-swell, depth to rock.	Severe: depth to rock, shrink-swell.	Severe: shrink-swell, depth to rock.	Severe: depth to rock, low strength, shrink-swell.	Severe: thin layer.
14*:						
Deama	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: large stones, droughty, slope.
Tovar	Severe: depth to rock, slope.	Severe: shrink-swell, slope.	Severe: depth to rock, slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, slope, shrink-swell.	Severe: large stones, slope.
15 Disterheff	Moderate: too clayey, slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Severe: small stones.
16*:						
Disterheff	Moderate: too clayey, slope.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Moderate: large stones.
Kopie	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Severe: droughty, thin layer.
17 Epikom	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: droughty, thin layer.
18*:						
Epikom	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: droughty, thin layer.
Epikom	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: droughty, thin layer.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
19*:						
Epikom	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: droughty, slope, thin layer.
Rock outcrop.						
20*:						
Faraway	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: droughty, slope, thin layer.
Rock outcrop.						
21*:						
Keeseha	Slight	Slight	Slight	Moderate: slope.	Slight	Moderate: small stones, droughty.
Poley	Slight	Slight	Slight	Moderate: slope.	Slight	Moderate: small stones.
22*:						
Kopie	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Severe: droughty, thin layer.
Servilleta	Severe: depth to rock.	Moderate: shrink-swell, depth to rock.	Severe: depth to rock.	Moderate: shrink-swell, slope, depth to rock.	Severe: low strength, shrink-swell.	Moderate: thin layer.
23*. Lava flows						
24*:						
Lomaki	Slight	Slight	Slight	Moderate: slope.	Moderate: frost action.	Severe: small stones droughty.
Nalaki	Moderate: cemented pan.	Slight	Moderate: cemented pan.	Moderate: slope.	Moderate: frost action.	Severe: small stones droughty.
25*:						
Mespun	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
Palma	Slight	Slight	Slight	Moderate: slope.	Slight	Slight.
26 Navajo	Moderate: too clayey.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: low strength, shrink-swell.	Severe: too clayey.
27 Palma	Slight	Slight	Slight	Slight	Slight	Slight.
28 Pastura	Severe: cemented pan.	Severe: cemented pan.	Severe: cemented pan.	Severe: cemented pan.	Severe: cemented pan.	Severe: droughty, thin layer.
29*:						
Paymaster	Slight	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding, frost action.	Slight.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
29*:						
Lynx	Slight	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength.	Slight.
30 Poley	Slight	Slight	Slight	Slight	Slight	Slight.
31 Poley	Slight	Slight	Slight	Moderate: slope.	Slight	Moderate: small stones.
32*:						
Poley	Slight	Slight	Slight	Moderate: slope.	Slight	Moderate: small stones.
Lynx	Slight	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength.	Slight.
33*:						
Poley	Slight	Slight	Slight	Moderate: slope.	Slight	Moderate: small stones.
Tusayan	Severe: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: slope, depth to rock.	Moderate: depth to rock.	Moderate: small stones, droughty, thin layer.
34 Purgatory	Moderate: depth to rock.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell, slope.	Moderate: low strength, shrink-swell.	Moderate: small stones, thin layer.
35 Quivera	Severe: cutbanks cave.	Severe: shrink-swell.	Slight	Severe: shrink-swell.	Severe: shrink-swell.	Severe: small stones.
36*. Riverwash						
37 Rune	Moderate: too clayey.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: low strength, shrink-swell.	Slight.
38*:						
Rune	Moderate: too clayey.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: low strength, shrink-swell.	Slight.
Disterheff	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Severe: large stones.
39 Servilleta	Severe: depth to rock.	Moderate: shrink-swell, depth to rock.	Severe: depth to rock.	Moderate: shrink-swell, slope, depth to rock.	Severe: low strength, shrink-swell.	Moderate: thin layer.
40*:						
Servilleta	Severe: depth to rock.	Moderate: shrink-swell, depth to rock.	Severe: depth to rock.	Moderate: shrink-swell, slope, depth to rock.	Severe: low strength, shrink-swell.	Moderate: thin layer.
Tusayan	Severe: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: slope, depth to rock.	Moderate: depth to rock.	Moderate: small stones, droughty, thin layer.
41 Showlow	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Moderate: small stones.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
42*: Showlow	Severe: slope.	Severe: shrink-swell, slope.	Severe: slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, slope, shrink-swell.	Severe: slope.
43, 44: Springerville	Severe: cutbanks cave.	Severe: shrink-swell.	Severe: depth to rock, shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Severe: large stones, too clayey.
45*:						
Tajo	Severe: cemented pan.	Moderate: cemented pan.	Severe: cemented pan.	Moderate: slope, cemented pan.	Moderate: cemented pan, low strength, frost action.	Moderate: small stones, large stones, thin layer.
Springerville	Severe: depth to rock, cutbanks cave.	Severe: shrink-swell.	Severe: depth to rock, shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Severe: large stones, too clayey.
46: Tenorio	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Severe: small stones.
47*:						
Thunderbird	Severe: depth to rock, slope.	Severe: shrink-swell, slope.	Severe: depth to rock, slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, slope, shrink-swell.	Severe: large stones, slope.
Cabezon	Severe: depth to rock, slope.	Severe: shrink-swell, slope, depth to rock.	Severe: depth to rock, slope, shrink-swell.	Severe: shrink-swell, slope, depth to rock.	Severe: depth to rock, low strength, slope.	Severe: large stones, slope, thin layer.
48*:						
Thunderbird	Severe: depth to rock, slope.	Severe: shrink-swell, slope.	Severe: depth to rock, slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, slope, shrink-swell.	Severe: large stones, slope.
Rock outcrop.						
49*:						
Thunderbird	Severe: depth to rock, slope.	Severe: shrink-swell, slope.	Severe: depth to rock, slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, slope, shrink-swell.	Severe: large stones, slope.
Springerville	Severe: depth to rock, cutbanks cave.	Severe: shrink-swell.	Severe: depth to rock, shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Severe: large stones, too clayey.
50*. Torrifluvents						
51: Tours	Slight	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength.	Slight.
52*:						
Tours	Slight	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength.	Slight.
Ives	Slight	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.	Slight.
53*:						
Tovar	Severe: depth to rock, slope.	Severe: shrink-swell, slope.	Severe: depth to rock, slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, slope, shrink-swell.	Severe: large stones, slope.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
53*:						
Tovar	Severe: depth to rock, slope.	Severe: shrink-swell, slope.	Severe: depth to rock, slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, slope, shrink-swell.	Moderate: large stones, slope.
54*:						
Tovar	Severe: depth to rock, slope.	Severe: shrink-swell, slope.	Severe: depth to rock, slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, slope, shrink-swell.	Severe: large stones, slope.
Tovar	Severe: depth to rock, slope.	Severe: shrink-swell, slope.	Severe: depth to rock, slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, slope, shrink-swell.	Severe: slope.
55*:						
Tusayan	Severe: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: slope, depth to rock.	Moderate: depth to rock.	Moderate: small stones, droughty, thin layer.
Lynx	Slight	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength.	Slight.
56 Tuweep	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope.	Severe: slope.	Severe: low strength.	Severe: small stones.
57 Valle	Slight	Slight	Moderate: shrink-swell.	Moderate: slope.	Moderate: frost action.	Moderate: small stones.
58 Wilaha	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
59*:						
Wilaha	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: droughty, slope.
Wukoki	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: small stones, droughty, slope.
60 Winona	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: droughty, thin layer.
61 Winona	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: large stones, droughty, thin layer.
62*:						
Winona	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: droughty, thin layer.
Boysag	Severe: depth to rock.	Severe: shrink-swell, depth to rock.	Severe: depth to rock, shrink-swell.	Severe: shrink-swell, depth to rock.	Severe: depth to rock, low strength.	Severe: droughty, thin layer.
63*:						
Winona	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: large stones, thin layer.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
63*:						
Epikom	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: droughty, thin layer.
64*, 65*:						
Winona	Severe: depth to rock, large stones, slope.	Severe: slope, depth to rock, large stones.	Severe: depth to rock, slope, large stones.	Severe: slope, depth to rock, large stones.	Severe: depth to rock, slope, large stones.	Severe: slope, droughty, thin layer.
Rock outcrop.						
66*:						
Winona	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: droughty, thin layer.
Tusayan	Severe: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: slope, depth to rock.	Moderate: depth to rock.	Moderate: small stones, droughty, thin layer.
67*:						
Wukoki	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: small stones, droughty, slope.
Rock outcrop.						
68*:						
Wukoki	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: small stones, droughty, slope.
Wupatki	Severe: cemented pan, slope.	Severe: slope.	Severe: cemented pan, slope.	Severe: slope.	Severe: slope.	Severe: small stones, droughty, slope.
69*:						
Wupatki	Severe: cemented pan.	Moderate: slope, cemented pan.	Severe: cemented pan.	Severe: slope.	Moderate: cemented pan, slope, frost action.	Severe: small stones, droughty, thin layer.
Wukoki	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Severe: small stones, droughty.
70 Ziegler	Slight	Slight	Slight	Moderate: slope.	Slight	Moderate: small stones, droughty.
71*:						
Ziegler	Slight	Slight	Slight	Moderate: slope.	Slight	Moderate: small stones, droughty.
Cross	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock, low strength.	Severe: large stones, droughty, thin layer.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
72*:						
Ziegler----------	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: small stones, droughty.
Wilaha-----------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
1------------------ Ashfork	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim, large stones.
2------------------ Aut	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim, small stones.
3*:					
Aut----------------	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim, small stones.
Cross--------------	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim, too clayey, large stones.
4*:					
Aut----------------	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim, small stones.
Lynx---------------	Severe: percs slowly.	Severe: flooding.	Moderate: flooding, too clayey.	Moderate: flooding.	Fair: too clayey.
5*:					
Badland.					
Torriorthents.					
6*:					
Boquillas----------	Severe: depth to rock, percs slowly.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim, small stones.
Seligman-----------	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey.
7------------------ Clovis	Slight-----------	Severe: seepage.	Slight-----------	Slight-----------	Good.
8*:					
Cross--------------	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim, too clayey.
Apache-------------	Severe: depth to rock.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock.	Poor: area reclaim, large stones.
9*:					
Daze---------------	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: area reclaim, too clayey, hard to pack.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
9*:					
Deama	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope.	Poor: area reclaim, large stones, slope.
10 Deama	Severe: depth to rock, large stones.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock.	Poor: area reclaim, large stones.
11 Deama	Severe: depth to rock, large stones.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock.	Poor: area reclaim, large stones.
12*:					
Deama	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope.	Poor: area reclaim, large stones, slope.
Rock outcrop.					
13*:					
Deama	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock.	Poor: area reclaim, large stones.
Toqui	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack.
14*:					
Deama	Severe: depth to rock, slope.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope.	Poor: area reclaim, large stones, slope.
Tovar	Severe: depth to rock, percs slowly, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope, too clayey.	Severe: depth to rock, slope.	Poor: area reclaim, too clayey, hard to pack.
15 Disterheff	Severe: percs slowly.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Poor: small stones.
16*:					
Disterheff	Severe: percs slowly.	Moderate: slope, large stones.	Moderate: too clayey.	Slight	Poor: small stones.
Kopie	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
17 Epikom	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
18*:					
Epikom	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
18*:					
Epikom-------------	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
19*:					
Epikom-------------	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: area reclaim, slope.
Rock outcrop.					
20*:					
Faraway------------	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: area reclaim, slope, small stones.
Rock outcrop.					
21*:					
Keeseha------------	Severe: poor filter.	Severe: seepage.	Severe: seepage.	Severe: seepage.	Poor: small stones.
Poley--------------	Moderate: percs slowly.	Moderate: seepage, slope.	Slight-----------	Slight-----------	Poor: small stones.
22*:					
Kopie--------------	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
Servilleta---------	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
23*. Lava flows					
24*:					
Lomaki-------------	Severe: poor filter.	Severe: seepage.	Severe: seepage.	Severe: seepage.	Poor: seepage, small stones.
Nalaki-------------	Severe: cemented pan, poor filter.	Severe: seepage, cemented pan.	Severe: seepage.	Severe: cemented pan, seepage.	Poor: area reclaim, seepage, small stones.
25*:					
Mespun-------------	Severe: poor filter.	Severe: seepage.	Severe: too sandy.	Slight-----------	Poor: seepage, too sandy.
Palma--------------	Slight-----------	Severe: seepage.	Slight-----------	Slight-----------	Good.
26----------------- Navajo	Severe: percs slowly.	Severe: flooding.	Moderate: flooding.	Moderate: flooding.	Poor: hard to pack.
27----------------- Palma	Slight-----------	Severe: seepage.	Slight-----------	Slight-----------	Good.
28----------------- Pastura	Severe: cemented pan.	Severe: cemented pan.	Severe: cemented pan.	Severe: cemented pan.	Poor: area reclaim.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
29*:					
Paymaster	Moderate: flooding, percs slowly.	Severe: seepage, flooding.	Severe: seepage.	Moderate: flooding.	Good.
Lynx	Severe: percs slowly.	Severe: flooding.	Moderate: flooding, too clayey.	Moderate: flooding.	Fair: too clayey.
30, 31 Poley	Moderate: percs slowly.	Moderate: seepage, slope.	Slight	Slight	Poor: small stones.
32*:					
Poley	Moderate: percs slowly.	Moderate: seepage, slope.	Slight	Slight	Poor: small stones.
Lynx	Severe: percs slowly.	Severe: flooding.	Moderate: flooding, too clayey.	Moderate: flooding.	Fair: too clayey.
33*:					
Poley	Moderate: percs slowly.	Moderate: seepage, slope.	Slight	Slight	Poor: small stones.
Tusayan	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim, small stones.
34 Purgatory	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
35 Quivera	Severe: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Poor: seepage, small stones.
36*. Riverwash					
37 Rune	Severe: percs slowly.	Severe: flooding.	Severe: too clayey.	Moderate: flooding.	Poor: too clayey, hard to pack.
38*:					
Rune	Severe: percs slowly.	Severe: flooding.	Severe: too clayey.	Moderate: flooding.	Poor: too clayey, hard to pack.
Disterheff	Severe: percs slowly.	Moderate: slope, large stones.	Moderate: too clayey.	Slight	Poor: small stones.
39 Servilleta	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
40*:					
Servilleta	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
Tusayan	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim, small stones.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
41------------------ Showlow	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight-----------	Poor: too clayey, hard to pack.
42*----------------- Showlow	Severe: percs slowly, slope.	Severe: slope.	Severe: slope, too clayey.	Severe: slope.	Poor: too clayey, hard to pack, slope.
43, 44-------------- Springerville	Severe: percs slowly.	Moderate: depth to rock, slope.	Severe: depth to rock, too clayey.	Slight-----------	Poor: too clayey, hard to pack.
45*:					
Tajo---------------	Severe: cemented pan, percs slowly.	Severe: cemented pan, slope.	Severe: cemented pan.	Severe: cemented pan.	Poor: area reclaim.
Springerville------	Severe: percs slowly.	Severe: slope.	Severe: depth to rock, too clayey.	Slight-----------	Poor: too clayey, hard to pack.
46------------------ Tenorio	Severe: poor filter.	Severe: seepage.	Severe: too sandy.	Slight-----------	Poor: seepage, too sandy, small stones.
47*:					
Thunderbird--------	Severe: depth to rock, percs slowly, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope, too clayey.	Severe: depth to rock, slope.	Poor: area reclaim, too clayey, hard to pack.
Cabezon------------	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope, too clayey.	Severe: depth to rock, slope.	Poor: area reclaim, too clayey, hard to pack.
48*:					
Thunderbird--------	Severe: depth to rock, percs slowly, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope, too clayey.	Severe: depth to rock, slope.	Poor: area reclaim, too clayey, hard to pack.
Rock outcrop.					
49*:					
Thunderbird--------	Severe: depth to rock, percs slowly, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope, too clayey.	Severe: depth to rock, slope.	Poor: area reclaim, too clayey, hard to pack.
Springerville------	Severe: percs slowly.	Moderate: slope.	Severe: depth to rock, too clayey.	Slight-----------	Poor: too clayey, hard to pack.
50*. Torrifluvents					
51------------------ Tours	Severe: percs slowly.	Severe: flooding.	Moderate: flooding.	Moderate: flooding.	Good.
52*:					
Tours--------------	Severe: percs slowly.	Severe: flooding.	Moderate: flooding.	Moderate: flooding.	Good.
Ives---------------	Moderate: flooding.	Severe: flooding.	Moderate: flooding.	Moderate: flooding.	Good.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
53*:					
Tovar	Severe: depth to rock, percs slowly, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope, too clayey.	Severe: depth to rock, slope.	Poor: area reclaim, too clayey, hard to pack.
Tovar	Severe: depth to rock, percs slowly, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope, too clayey.	Severe: depth to rock, slope.	Poor: area reclaim, too clayey, hard to pack.
54*:					
Tovar	Severe: depth to rock, percs slowly, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope, too clayey.	Severe: depth to rock, slope.	Poor: area reclaim, too clayey, hard to pack.
Tovar	Severe: depth to rock, percs slowly, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope, too clayey.	Severe: depth to rock, slope.	Poor: area reclaim, too clayey, hard to pack.
55*:					
Tusayan	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim, small stones.
Lynx	Severe: percs slowly.	Severe: flooding.	Moderate: flooding, too clayey.	Moderate: flooding.	Fair: too clayey.
56 Tuweep	Severe: percs slowly.	Moderate: seepage, slope.	Severe: large stones.	Slight	Poor: large stones.
57 Valle	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Poor: small stones.
58 Wilaha	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Poor: seepage, small stones, slope.
59*:					
Wilaha	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Poor: seepage, small stones, slope.
Wukoki	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Poor: seepage, small stones, slope.
60, 61 Winona	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock.	Poor: area reclaim, large stones.
62*:					
Winona	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock.	Poor: area reclaim, large stones.
Boysag	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
63*:					
Winona	Severe: depth to rock, large stones.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock.	Poor: area reclaim, large stones.
Epikom	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
64*, 65*:					
Winona	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope.	Poor: area reclaim, large stones.
Rock outcrop.					
66*:					
Winona	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock.	Poor: area reclaim, large stones.
Tusayan	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim, small stones.
67*:					
Wukoki	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Poor: seepage, small stones, slope.
Rock outcrop.					
68*:					
Wukoki	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Poor: seepage, small stones, slope.
Wupatki	Severe: cemented pan, poor filter, slope.	Severe: seepage, cemented pan, slope.	Severe: seepage, slope.	Severe: cemented pan, seepage, slope.	Poor: area reclaim, seepage, small stones.
69*:					
Wupatki	Severe: cemented pan, poor filter.	Severe: seepage, cemented pan, slope.	Severe: seepage.	Severe: cemented pan, seepage.	Poor: area reclaim, seepage, small stones.
Wukoki	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Poor: seepage, small stones.
70 Ziegler	Severe: poor filter.	Severe: seepage.	Severe: seepage.	Severe: seepage.	Poor: seepage, small stones.
71*:					
Ziegler	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Poor: seepage, small stones.
Cross	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim, too clayey, large stones.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
72*:					
Ziegler	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Poor: seepage, small stones.
Wilaha	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Poor: seepage, small stones, slope.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," "poor," "probable," and "improbable." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
1 Ashfork	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
2 Aut	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
3*:				
Aut	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
Cross	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, large stones.
4*:				
Aut	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
Lynx	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
5*:				
Badland.				
Torriorthents.				
6*:				
Boquillas	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
Seligman	Poor: area reclaim, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, too clayey, small stones.
7 Clovis	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy.
8*:				
Cross	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, large stones.
Apache	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, large stones.
9*:				
Daze	Poor: area reclaim, low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, slope.
Deama	Poor: area reclaim, slope.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: area reclaim, large stones, slope.
10 Deama	Poor: area reclaim.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: area reclaim, large stones.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
11-------------------- Deama	Poor: area reclaim, large stones.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: area reclaim, large stones.
12*:				
Deama----------------	Poor: area reclaim, large stones.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: area reclaim, large stones, slope.
Rock outcrop.				
13*:				
Deama----------------	Poor: area reclaim.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: area reclaim, large stones.
Toqui----------------	Poor: area reclaim, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, too clayey, small stones.
14*:				
Deama----------------	Poor: area reclaim, slope, large stones.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: area reclaim, large stones, slope.
Tovar----------------	Poor: area reclaim, low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: large stones, slope.
15-------------------- Disterheff	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, area reclaim.
16*:				
Disterheff-----------	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, area reclaim.
Kopie----------------	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones.
17-------------------- Epikom	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: areas reclaim, small stones.
18*:				
Epikom---------------	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones.
Epikom---------------	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones.
19*:				
Epikom---------------	Poor: area reclaim, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones.
Rock outcrop.				

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
20*:				
Faraway	Poor: area reclaim, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, slope.
Rock outcrop.				
21*:				
Keeseha	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim.
Poley	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim.
22*:				
Kopie	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones.
Servilleta	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, small stones.
23*. Lava flows				
24*:				
Lomaki	Good	Improbable: small stones.	Probable	Poor: small stones, area reclaim.
Nalaki	Good	Improbable: small stones.	Probable	Poor: small stones, area reclaim.
25*:				
Mespun	Good	Probable	Improbable: too sandy.	Poor: too sandy.
Palma	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
26 Navajo	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
27 Palma	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
28 Pastura	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones.
29*:				
Paymaster	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Lynx	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
30, 31 Poley	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
32*:				
Poley	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim.
Lynx	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
33*:				
Poley	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim.
Tusayan	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
34 Purgatory	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, small stones, thin layer.
35 Quivera	Fair: shrink-swell.	Improbable: small stones.	Probable	Poor: small stones, area reclaim.
36*. Riverwash				
37 Rune	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
38*:				
Rune	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Disterheff	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, area reclaim.
39 Servilleta	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, small stones.
40*:				
Servilleta	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, small stones.
Tusayan	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
41 Showlow	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, small stones.
42* Showlow	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, small stones, slope.
43, 44 Springerville	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
45*:				
Tajo	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, too clayey, small stones.
Springerville	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
46 Tenorio	Good	Improbable: small stones.	Probable	Poor: small stones, area reclaim.
47*:				
Thunderbird	Poor: area reclaim, low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Cabezon	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, thin layer, slope.
48*:				
Thunderbird	Poor: area reclaim, low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: large stones, slope.
Rock outcrop.				
49*:				
Thunderbird	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: large stones, slope.
Springerville	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
50*. Torrifluvents				
51 Tours	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
52*:				
Tours	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
Ives	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
53*:				
Tovar	Poor: area reclaim, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, large stones.
Tovar	Poor: area reclaim, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, large stones.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
54*:				
Tovar	Poor: area reclaim, low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, large stones, slope.
Tovar	Poor: area reclaim, low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, large stones, slope.
55*:				
Tusayan	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
Lynx	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
56 Tuweep	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones.
57 Valle	Fair: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim.
58 Wilaha	Poor: slope.	Improbable: small stones.	Probable	Poor: small stones, area reclaim, slope.
59*:				
Wilaha	Poor: slope.	Improbable: small stones.	Probable	Poor: small stones, area reclaim, slope.
Wukoki	Poor: slope.	Improbable: small stones.	Probable	Poor: small stones, area reclaim, slope.
60, 61 Winona	Poor: area reclaim, large stones.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: area reclaim, large stones.
62*:				
Winona	Poor: area reclaim, large stones.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: area reclaim, large stones.
Boysag	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones.
63*:				
Winona	Poor: area reclaim, large stones.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: area reclaim, large stones.
Epikom	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim.
64*:				
Winona	Poor: area reclaim, large stones.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: area reclaim, large stones, slope.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
64*:				
Rock outcrop.				
65*:				
Winona	Poor: area reclaim, large stones, slope.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: area reclaim, large stones, slope.
Rock outcrop.				
66*:				
Winona	Poor: area reclaim, large stones.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: area reclaim, large stones.
Tusayan	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
67*:				
Wukoki	Fair: slope.	Improbable: small stones.	Probable	Poor: small stones, area reclaim, slope.
Rock outcrop.				
68*:				
Wukoki	Poor: slope.	Improbable: small stones.	Probable	Poor: small stones, area reclaim, slope.
Wupatki	Poor: slope.	Improbable: small stones.	Probable	Poor: area reclaim, small stones, slope.
69*:				
Wupatki	Good	Improbable: small stones.	Probable	Poor: area reclaim, small stones.
Wukoki	Good	Improbable: small stones.	Probable	Poor: small stones, area reclaim.
70 Ziegler	Good	Improbable: small stones.	Probable	Poor: small stones, area reclaim.
71*:				
Ziegler	Good	Improbable: small stones.	Probable	Poor: small stones, area reclaim.
Cross	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, large stones.
72*:				
Ziegler	Good	Improbable: small stones.	Probable	Poor: small stones, area reclaim.
Wilaha	Fair: slope.	Improbable: small stones.	Probable	Poor: small stones, area reclaim, slope.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated]

Soil name and map symbol	Limitations for-- Pond reservoir areas	Limitations for-- Embankments, dikes, and levees	Features affecting-- Irrigation	Features affecting-- Terraces and diversions
1----------------- Ashfork	Severe: slope.	Moderate: thin layer, large stones.	Percs slowly, depth to rock, slope.	Slope, depth to rock, percs slowly.
2----------------- Aut	Moderate: seepage, depth to rock, slope.	Severe: piping.	Depth to rock, slope.	Large stones, depth to rock.
3*:				
Aut---------------	Moderate: seepage, depth to rock, slope.	Severe: piping.	Depth to rock, slope.	Large stones, depth to rock.
Cross-------------	Severe: depth to rock, slope.	Severe: thin layer, large stones.	Large stones, droughty, percs slowly.	Slope, large stones, depth to rock.
4*:				
Aut---------------	Moderate: seepage, depth to rock, slope.	Severe: piping.	Depth to rock, slope.	Large stones, depth to rock.
Lynx--------------	Moderate: slope.	Moderate: piping.	Slope-----------------	Favorable.
5*:				
Badland.				
Torriorthents.				
6*:				
Boquillas---------	Severe: slope.	Moderate: thin layer.	Percs slowly, depth to rock, slope.	Slope, depth to rock.
Seligman----------	Severe: depth to rock, slope.	Severe: thin layer.	Percs slowly, depth to rock, slope.	Slope, depth to rock, percs slowly.
7----------------- Clovis	Severe: seepage.	Severe: seepage, piping.	Fast intake, soil blowing, slope.	Soil blowing.
8*:				
Cross-------------	Severe: depth to rock, slope.	Severe: thin layer.	Percs slowly, depth to rock, slope.	Slope, large stones, depth to rock.
Apache------------	Severe: depth to rock, slope.	Severe: thin layer, large stones.	Large stones, droughty, depth to rock.	Slope, large stones, depth to rock.
9*:				
Daze--------------	Severe: depth to rock, slope.	Severe: thin layer.	Percs slowly, depth to rock, slope.	Slope, depth to rock, percs slowly.
Deama-------------	Severe: depth to rock, slope.	Severe: thin layer.	Droughty, depth to rock, slope.	Slope, depth to rock.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Irrigation	Terraces and diversions
10----------------- Deama	Severe: depth to rock, slope.	Severe: thin layer.	Droughty, depth to rock, slope.	Slope, depth to rock.
11, 12*:				
Deama------------	Severe: depth to rock, slope.	Severe: thin layer, large stones.	Large stones, droughty, depth to rock.	Slope, large stones, depth to rock.
Rock outcrop.				
13*:				
Deama------------	Severe: depth to rock.	Severe: thin layer.	Droughty, depth to rock, slope.	Depth to rock.
Toqui------------	Severe: depth to rock.	Severe: thin layer.	Droughty, percs slowly, depth to rock.	Depth to rock, percs slowly.
14*:				
Deama------------	Severe: depth to rock, slope.	Severe: thin layer, large stones.	Large stones, droughty, depth to rock.	Slope, large stones, depth to rock.
Tovar------------	Severe: slope.	Severe: large stones.	Large stones, percs slowly, depth to rock.	Slope, large stones, depth to rock.
15----------------- Disterheff	Severe: slope.	Severe: piping.	Percs slowly, slope.	Slope, percs slowly.
16*:				
Disterheff--------	Severe: slope.	Severe: piping.	Percs slowly, slope.	Slope, large stones, percs slowly.
Kopie------------	Severe: depth to rock, slope.	Severe: piping.	Depth to rock, slope.	Slope, depth to rock.
17----------------- Epikom	Severe: depth to rock.	Severe: thin layer.	Droughty, fast intake, depth to rock.	Depth to rock.
18*:				
Epikom-----------	Severe: depth to rock.	Severe: thin layer.	Droughty, depth to rock, slope.	Slope, depth to rock.
Epikom-----------	Severe: depth to rock.	Severe: thin layer.	Droughty, depth to rock, slope.	Slope, depth to rock.
19*:				
Epikom-----------	Severe: depth to rock, slope.	Severe: thin layer.	Droughty, depth to rock, slope.	Slope, depth to rock.
Rock outcrop.				
20*:				
Faraway----------	Severe: depth to rock, slope.	Severe: thin layer.	Droughty, depth to rock, slope.	Slope, depth to rock.
Rock outcrop.				

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Irrigation	Terraces and diversions
21*:				
Keeseha	Severe: seepage.	Severe: seepage.	Droughty, soil blowing, slope.	Soil blowing.
Poley	Moderate: seepage, slope.	Moderate: seepage, piping.	Soil blowing, percs slowly, slope.	Soil blowing, percs slowly.
22*:				
Kopie	Severe: depth to rock, slope.	Severe: piping.	Depth to rock, slope.	Slope, depth to rock.
Servilleta	Moderate: depth to rock, slope.	Moderate: thin layer.	Soil blowing, percs slowly, depth to rock.	Depth to rock, erodes easily.
23*. Lava flows				
24*:				
Lomaki	Severe: seepage.	Severe: seepage.	Droughty, slope.	Favorable.
Nalaki	Severe: seepage.	Severe: seepage.	Droughty, cemented pan, slope.	Cemented pan.
25*:				
Mespun	Severe: seepage.	Severe: seepage, piping.	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.
Palma	Severe: seepage.	Severe: piping.	Soil blowing	Soil blowing.
26 Navajo	Slight	Moderate: hard to pack.	Slow intake, percs slowly.	Percs slowly.
27 Palma	Severe: seepage.	Severe: piping.	Soil blowing	Soil blowing.
28 Pastura	Severe: cemented pan.	Severe: thin layer, piping.	Droughty, cemented pan, slope.	Cemented pan.
29*:				
Paymaster	Moderate: seepage, slope.	Severe: piping.	Soil blowing, slope.	Soil blowing.
Lynx	Slight	Moderate: piping.	Favorable	Favorable.
30 Poley	Moderate: seepage.	Moderate: seepage, piping.	Percs slowly, slope.	Percs slowly.
31 Poley	Moderate: seepage, slope.	Moderate: seepage, piping.	Percs slowly, slope.	Percs slowly.
32*:				
Poley	Moderate: seepage, slope.	Moderate: seepage, piping.	Percs slowly, slope.	Percs slowly.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Irrigation	Terraces and diversions
32*:				
Lynx	Slight	Moderate: piping.	Slope	Favorable.
33*:				
Poley	Moderate: seepage, slope.	Moderate: seepage, piping.	Percs slowly, slope.	Percs slowly.
Tusayan	Moderate: seepage, depth to rock, slope.	Severe: thin layer.	Droughty, depth to rock, slope.	Depth to rock.
34 Purgatory	Moderate: seepage, depth to rock, slope.	Severe: thin layer.	Soil blowing, depth to rock, slope.	Depth to rock, erodes easily, soil blowing.
35 Quivera	Moderate: seepage, slope.	Severe: seepage.	Percs slowly, slope.	Percs slowly.
36*. Riverwash				
37 Rune	Moderate: slope.	Moderate: hard to pack.	Percs slowly, slope.	Percs slowly.
38*:				
Rune	Slight	Moderate: hard to pack.	Percs slowly	Percs slowly.
Disterheff	Moderate: slope.	Moderate: piping.	Percs slowly, slope.	Large stones, percs slowly.
39 Servilleta	Moderate: depth to rock, slope.	Moderate: thin layer.	Soil blowing, percs slowly, depth to rock.	Depth to rock, erodes easily.
40*:				
Servilleta	Moderate: depth to rock, slope.	Moderate: thin layer.	Soil blowing, percs slowly, depth to rock.	Depth to rock, erodes easily.
Tusayan	Moderate: seepage, depth to rock, slope.	Severe: thin layer.	Droughty, depth to rock, slope.	Depth to rock.
41 Showlow	Moderate: slope.	Moderate: hard to pack.	Percs slowly, slope.	Percs slowly.
42* Showlow	Severe: slope.	Moderate: hard to pack.	Percs slowly, slope.	Slope, percs slowly.
43, 44 Springerville	Moderate: depth to rock, slope.	Severe: hard to pack.	Slow intake, percs slowly.	Percs slowly.
45*:				
Tajo	Severe: slope.	Severe: thin layer.	Cemented pan, slope.	Slope, cemented pan.
Springerville	Severe: slope.	Severe: hard to pack.	Slow intake, percs slowly.	Percs slowly.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Irrigation	Terraces and diversions
46----------------- Tenorio	Severe: seepage.	Severe: seepage.	Droughty, slope.	Too sandy.
47*:				
Thunderbird-------	Severe: slope.	Moderate: thin layer, hard to pack.	Percs slowly-----------	Slope, percs slowly.
Cabezon-----------	Severe: depth to rock, slope.	Severe: thin layer.	Droughty, percs slowly, depth to rock.	Slope, depth to rock.
48*:				
Thunderbird-------	Severe: slope.	Moderate: hard to pack.	Percs slowly, depth to rock, slope.	Slope, depth to rock, percs slowly.
Rock outcrop.				
49*:				
Thunderbird-------	Severe: slope.	Moderate: hard to pack.	Percs slowly, depth to rock, slope.	Slope, depth to rock, percs slowly.
Springerville-----	Moderate: depth to rock, slope.	Severe: hard to pack.	Slow intake, percs slowly.	Percs slowly.
50*. Torrifluvents				
51----------------- Tours	Slight-----------------	Moderate: piping.	Slope------------------	Erodes easily.
52*:				
Tours-------------	Moderate: slope.	Moderate: piping.	Soil blowing, slope.	Erodes easily, soil blowing.
Ives--------------	Moderate: seepage, slope.	Moderate: piping.	Soil blowing, slope.	Soil blowing.
53*, 54*:				
Tovar-------------	Severe: slope.	Moderate: hard to pack, large stones.	Large stones, percs slowly, depth to rock.	Slope, large stones, depth to rock.
Tovar-------------	Severe: slope.	Severe: hard to pack, thin layer.	Soil blowing, percs slowly, depth to rock.	Slope, depth to rock, soil blowing.
55*:				
Tusayan-----------	Moderate: seepage, depth to rock, slope.	Severe: thin layer.	Droughty, depth to rock, slope.	Depth to rock.
Lynx--------------	Moderate: slope.	Moderate: piping.	Slope------------------	Favorable.
56----------------- Tuweep	Moderate: seepage, slope.	Severe: piping.	Slope------------------	Large stones.
57----------------- Valle	Moderate: seepage, slope.	Slight-----------------	Slope------------------	Favorable.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Irrigation	Terraces and diversions
58---------------- Wilaha	Severe: seepage, slope.	Severe: seepage.	Droughty, slope.	Slope.
59*:				
Wilaha-----------	Severe: seepage, slope.	Severe: seepage.	Droughty, slope.	Slope.
Wukoki-----------	Severe: seepage, slope.	Severe: seepage.	Droughty, slope.	Slope.
60---------------- Winona	Severe: depth to rock.	Severe: thin layer, seepage, large stones.	Large stones, droughty, depth to rock.	Large stones, depth to rock.
61---------------- Winona	Severe: depth to rock.	Severe: thin layer, seepage, large stones.	Large stones, droughty, depth to rock.	Large stones, depth to rock.
62*:				
Winona-----------	Severe: depth to rock.	Severe: thin layer, seepage, large stones.	Large stones, droughty, depth to rock.	Large stones, depth to rock.
Boysag-----------	Severe: depth to rock.	Severe: thin layer.	Percs slowly, depth to rock, slope.	Depth to rock, percs slowly.
63*:				
Winona-----------	Severe: depth to rock.	Severe: thin layer, seepage, large stones.	Large stones, droughty, depth to rock.	Large stones, depth to rock.
Epikom-----------	Severe: depth to rock.	Severe: thin layer.	Droughty, depth to rock, slope.	Slope, depth to rock.
64*, 65*:				
Winona-----------	Severe: depth to rock, slope.	Severe: thin layer, seepage, large stones.	Large stones, droughty, depth to rock.	Slope, large stones, depth to rock.
Rock outcrop.				
66*:				
Winona-----------	Severe: depth to rock.	Severe: thin layer, seepage, large stones.	Large stones, droughty, slope.	Large stones, depth to rock.
Tusayan----------	Moderate: seepage, depth to rock, slope.	Severe: thin layer.	Droughty, depth to rock, slope.	Depth to rock.
67*:				
Wukoki-----------	Severe: seepage, slope.	Severe: seepage.	Droughty, slope.	Slope.
Rock outcrop.				

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Irrigation	Terraces and diversions
68*:				
Wukoki	Severe: seepage, slope.	Severe: seepage.	Droughty, slope.	Slope.
Wupatki	Severe: seepage, cemented pan, slope.	Severe: thin layer, seepage.	Droughty, cemented pan, slope.	Slope, cemented pan.
69*:				
Wupatki	Severe: seepage, cemented pan, slope.	Severe: thin layer, seepage.	Droughty, cemented pan, slope.	Slope, cemented pan.
Wukoki	Severe: seepage, slope.	Severe: seepage.	Droughty, slope.	Slope.
70 Ziegler	Severe: seepage.	Severe: seepage.	Droughty, percs slowly, slope.	Favorable.
71*:				
Ziegler	Severe: seepage.	Severe: seepage.	Droughty, percs slowly, slope.	Favorable.
Cross	Severe: depth to rock, slope.	Severe: thin layer, large stones.	Large stones, droughty, percs slowly.	Slope, large stones, depth to rock.
72*:				
Ziegler	Severe: seepage, slope.	Severe: seepage.	Droughty, percs slowly, slope.	Slope.
Wilaha	Severe: seepage, slope.	Severe: seepage.	Droughty, slope.	Slope.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--ENGINEERING INDEX PROPERTIES

[The symbol > means more than. Absence of an entry indicates that data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification Unified	Classification AASHTO	Frag- ments > 3 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
1----------------Ashfork	0-2	Gravelly clay loam.	CL, GC	A-6	0	55-80	50-75	45-70	35-60	30-40	15-20
	2-17	Clay, clay loam	CL, CH	A-7	0	95-100	90-95	80-90	70-80	40-55	20-35
	17-30	Stony loam, stony clay loam.	CL	A-6	25-35	90-100	75-80	65-75	50-60	30-40	10-15
	30	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
2----------------Aut	0-7	Gravelly loam----	CL-ML	A-4	0-5	75-85	65-75	60-70	50-55	20-30	5-10
	7-26	Gravelly loam, cobbly loam.	CL-ML	A-4	5-15	75-85	55-75	50-65	50-60	20-30	5-10
	26-38	Cobbly loam------	CL-ML	A-4	20-30	75-85	70-80	60-75	50-60	20-30	5-10
	38	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
3*: Aut-------------	0-7	Gravelly loam----	CL-ML	A-4	0-5	75-85	65-75	60-70	50-55	20-30	5-10
	7-26	Gravelly loam, cobbly loam.	CL-ML	A-4	5-15	75-85	55-75	50-65	50-60	20-30	5-10
	26-38	Cobbly loam------	CL-ML	A-4	20-30	75-85	70-80	60-75	50-60	20-30	5-10
	38	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Cross-----------	0-3	Very stony clay loam.	ML, CL	A-6	50-70	85-90	80-85	75-85	60-70	35-40	10-15
	3-14	Clay, clay loam	CL, CH	A-7	0	85-100	80-90	75-85	60-75	40-55	20-30
	14-19	Cobbly clay loam	CL	A-7	25-35	90-100	80-90	75-85	55-70	40-45	15-20
	19	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
4*: Aut-------------	0-7	Gravelly loam----	CL-ML	A-4	0-5	75-85	65-75	60-70	50-55	20-30	5-10
	7-26	Gravelly loam, cobbly loam.	CL-ML	A-4	5-15	75-85	55-75	50-65	50-60	20-30	5-10
	26-38	Cobbly loam------	CL-ML	A-4	20-30	75-85	70-80	60-75	50-60	20-30	5-10
	38	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Lynx------------	0-2	Loam-------------	CL-ML, SM-SC	A-4	0	90-100	90-100	70-80	40-60	20-25	5-10
	2-60	Clay loam, loam, silt loam.	CL	A-6	0	95-100	95-100	80-90	60-75	30-40	10-20
5*: Badland.											
Torriorthents.											
6*: Boquillas--------	0-3	Gravelly loam----	CL-ML, SM-SC	A-4	0-15	75-85	65-75	55-70	40-55	25-30	5-10
	3-23	Gravelly clay, clay loam, clay.	CL	A-7	0-10	70-95	65-90	60-80	50-70	40-50	15-25
	23-38	Very gravelly clay loam.	GC	A-2, A-6, A-7	0-10	50-60	40-50	35-50	30-40	35-45	15-20
	38	Weathered bedrock	---	---	---	---	---	---	---	---	---
Seligman--------	0-3	Very gravelly clay loam.	GM-GC, GC	A-2, A-4, A-6	0-5	45-55	40-50	30-45	30-40	25-40	5-15
	3-15	Clay, gravelly clay, gravelly clay loam.	CL	A-7	0-5	80-95	70-90	55-85	50-70	40-50	15-25
	15	Weathered bedrock	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
7 Clovis	0-5	Loamy sand	SM	A-2	0	100	100	50-75	15-20	---	NP
	5-17	Sandy clay loam, clay loam.	SC	A-6	0	100	100	85-95	50-70	30-40	10-15
	17-60	Very fine sandy loam, sandy loam, loam.	SM, SM-SC, CL, CL-ML	A-4	0	100	100	70-85	40-60	15-25	NP-10
8*:											
Cross	0-3	Gravelly clay loam.	GM, SM, ML, SC	A-6	0-15	65-80	55-75	50-75	40-60	35-40	10-15
	3-14	Clay, clay loam	CL, CH	A-7	0	95-100	90-95	75-85	70-80	40-55	20-30
	14-19	Cobbly clay loam	CL	A-7	25-35	90-100	80-90	75-85	55-70	40-45	15-20
	19	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Apache	0-8	Cobbly clay loam	CL	A-6	25-40	80-100	75-95	65-90	50-75	30-40	10-20
	8-18	Gravelly loam, cobbly loam.	CL-ML	A-4	0-20	75-85	65-75	60-70	50-55	20-30	5-10
	18	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
9*:											
Daze	0-12	Gravelly loam	SM, SM-SC	A-4	0-15	85-95	60-75	55-65	40-50	20-30	NP-10
	12-19	Gravelly clay, gravelly clay loam.	CL, CH	A-7	0-10	85-95	60-75	55-70	50-60	40-55	20-35
	19	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Deama	0-7	Gravelly loam	GM, SM, GM-GC, SM-SC	A-2, A-4	0-10	65-80	60-75	50-70	35-55	20-30	NP-10
	7-19	Very cobbly loam	SM, SM-SC	A-4	50-60	75-85	65-75	55-70	40-50	20-30	NP-10
	19	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
10 Deama	0-7	Gravelly loam	GM, SM, GM-GC, SM-SC	A-2, A-4	0-10	65-80	60-75	50-70	35-55	20-30	NP-10
	7-19	Very cobbly loam	SM, SM-SC	A-4	50-60	75-85	65-75	55-70	40-50	20-30	NP-10
	19	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
11 Deama	0-7	Stony loam	SM, SM-SC	A-4	20-25	75-85	65-75	55-70	40-50	20-30	NP-10
	7-19	Very cobbly loam	SM, SM-SC	A-4	50-60	75-85	65-75	55-70	40-50	20-30	NP-10
	19	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
12*:											
Deama	0-7	Stony loam	SM, SM-SC	A-4	10-25	75-85	65-75	55-70	40-50	20-30	NP-10
	7-19	Very cobbly loam	SM, SM-SC	A-4	50-60	75-85	65-75	55-70	40-50	20-30	NP-10
	19	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop.											
13*:											
Deama	0-7	Gravelly loam	GM, SM, GM-GC, SM-SC	A-2, A-4	0-10	65-80	60-75	50-70	35-50	20-30	NP-10
	7-19	Very cobbly loam	SM, SM-SC	A-4	50-60	75-85	65-75	55-70	40-50	20-30	NP-10
	19	Unweathered bedrock.	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
13*:											
Toqui-----------	0-3	Fine sandy loam, very fine sandy loam.	SM	A-4	0	100	95-100	70-85	35-45	15-20	NP-5
	3-15	Clay loam, clay, gravelly clay.	CL, CH	A-7	0	80-100	70-95	65-90	55-80	35-55	15-30
	15-19	Very gravelly clay loam, gravelly loam, gravelly clay loam.	GC, SC	A-2, A-6	0	55-80	45-75	40-70	30-50	30-40	10-15
	19	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
14*:											
Deama-----------	0-7	Extremely stony loam.	SM, SM-SC	A-4	50-60	75-85	65-75	55-70	40-50	25-30	NP-10
	7-19	Very cobbly loam.	SM, SM-SC	A-4	50-60	75-85	65-75	55-70	40-50	20-30	NP-10
	19	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Tovar-----------	0-3	Stony loam-------	SM, SM-SC	A-4	25-40	85-90	80-85	60-70	35-50	20-30	NP-10
	3-8	Flaggy sandy clay loam, flaggy clay loam.	SM, ML	A-6, A-7	20-35	85-90	80-85	70-85	45-60	35-45	10-15
	8-35	Flaggy clay, flaggy clay loam.	CL, CH	A-7	20-35	85-90	80-85	70-85	65-75	40-60	15-35
	35	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
15--------------- Disterheff	0-6	Very gravelly sandy clay loam, gravelly clay loam.	GC	A-2	0-5	35-55	30-50	25-45	15-25	35-40	10-15
	6-24	Clay, clay loam, gravelly clay.	CH, CL	A-7	0	95-100	80-90	70-80	60-75	40-55	25-35
	24-60	Very cobbly clay, loam, very gravelly clay loam.	CL-ML	A-6	25-50	75-100	65-90	55-75	50-60	35-40	10-15
16*:											
Disterheff------	0-6	Cobbly loam------	CL-ML	A-4	25-40	90-100	85-90	70-85	50-70	20-30	5-10
	6-24	Clay, clay loam, gravelly clay.	CH, CL	A-7	0	95-100	80-90	70-80	60-75	40-55	25-35
	24-60	Very cobbly clay loam, very gravelly clay loam.	CL-ML	A-6	25-50	75-100	65-90	55-75	50-60	35-40	10-15
Kopie-----------	0-3	Gravelly fine sandy loam.	SM	A-2, A-4	0	70-80	65-75	45-65	25-40	20-25	NP-5
	3-15	Gravelly loam, loam.	CL-ML	A-4	0	75-90	65-85	55-70	50-55	20-30	5-10
	15	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
17--------------- Epikom	0-8	Very cindery loamy sand.	GP-GM, SP-SM	A-1	0-5	45-55	40-50	20-30	5-10	---	NP
	8-13	Sandy loam, loam, gravelly sandy loam.	SM, SM-SC	A-2, A-4	0-5	65-100	60-80	45-65	25-45	20-25	NP-10
	13	Unweathered bedrock.	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag-ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas-ticity index
	In				Pct					Pct	
18*:											
Epikom----------	0-3	Fine sandy loam	SM	A-4	0	95-100	90-100	60-85	35-45	20-25	NP-5
	3-15	Sandy loam, loam, gravelly loam.	SM, SM-SC	A-2, A-4	0-5	65-100	60-80	45-65	25-45	20-25	NP-10
	15	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Epikom----------	0-3	Gravelly fine sandy loam.	SM	A-2, A-1	0-5	65-85	50-75	30-50	20-30	20-30	NP-5
	3-15	Sandy loam, loam, gravelly loam.	SM, SM-SC	A-2, A-4	0-5	65-100	60-80	45-65	25-45	20-25	NP-10
	15	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
19*:											
Epikom----------	0-3	Gravelly fine sandy loam.	SM	A-2, A-1	0-5	65-85	50-75	30-50	20-30	20-30	NP-5
	3-15	Sandy loam, loam, gravelly loam.	SM, SM-SC	A-2, A-4	0-5	65-100	60-80	45-65	25-45	20-25	NP-10
	15	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop.											
20*:											
Faraway---------	0-7	Very gravelly loam.	GM, GM-GC	A-2, A-4	20-40	55-65	50-60	40-55	30-45	20-30	NP-10
	7-13	Very gravelly loam, very cobbly loam.	GM, GM-GC	A-2, A-4	25-50	55-65	50-60	40-55	30-45	20-30	NP-10
	13	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop.											
21*:											
Keeseha---------	0-4	Gravelly sandy loam, sandy clay loam.	SM	A-2	0	70-90	60-85	40-60	20-35	20-30	NP-5
	4-13	Clay, gravelly clay.	CL, CH	A-7	0	75-100	65-100	60-90	55-90	40-55	20-30
	13-20	Gravelly sandy clay loam.	SM, SM-SC	A-2, A-4	0	80-90	60-75	50-65	25-45	25-35	5-10
	20-60	Very gravelly sandy loam, gravelly sandy loam, gravelly sandy clay loam.	GM	A-1, A-2	0	40-70	35-60	20-45	10-20	20-30	NP-5
Poley-----------	0-4	Gravelly sandy loam.	GM, SM	A-2, A-4	0	65-85	60-75	40-60	30-45	15-20	NP-5
	4-10	Clay loam, sandy clay loam.	ML, CL	A-6	0	90-100	85-100	80-90	50-60	35-40	10-15
	10-22	Clay, clay loam	CL, CH	A-7	0	95-100	90-100	80-90	70-80	40-60	25-35
	22-40	Gravelly sandy clay loam, gravelly loam.	SM-SC	A-2, A-4	0	80-90	60-75	50-65	25-45	20-30	5-10
	40-60	Cobbly sandy loam, gravelly loam, very gravelly sandy loam.	GM, SM	A-2, A-1	10-30	55-75	50-70	40-50	20-35	15-20	NP-5

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
22*:											
Kopie-----------	0-2	Gravelly fine sandy loam.	SM	A-2, A-4	0	70-80	65-75	45-65	25-40	20-25	NP-5
	2-6	Loam-------------	CL-ML	A-4	0	100	95-100	80-95	55-65	20-30	5-10
	6-14	Channery loam, loam, gravelly loam.	CL-ML	A-4	25-35	75-95	65-85	55-70	50-55	20-30	5-10
	14	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Servilleta------	0-2	Fine sandy loam	SM, ML	A-4	0-5	95-100	90-100	70-80	40-70	20-25	NP-5
	2-17	Clay, clay loam	CL	A-7	0-5	90-100	85-100	80-90	70-80	40-50	20-35
	17-34	Gravelly clay loam, clay loam.	CL, SC, GC	A-6, A-7	0-5	60-90	50-85	45-75	35-60	35-45	15-20
	34	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
23*. Lava flows											
24*:											
Lomaki----------	0-3	Very cindery loam.	GM-GC	A-1, A-2	0	30-40	20-25	15-25	10-15	25-30	5-10
	3-24	Very cindery loam, extremely cindery loam.	GM, GM-GC	A-2, A-1	0	25-50	20-50	20-35	10-30	25-35	5-10
	24-60	Cinders----------	GP	A-1	0	5-10	0-5	0-5	0	---	NP
Nalaki----------	0-10	Very cindery loam.	GM, GM-GC	A-1, A-2	0	25-50	20-50	20-35	15-25	25-30	NP-10
	10-21	Very cindery loam, extremely cindery loam.	GM, GM-GC	A-1, A-2	0	25-50	20-50	20-35	15-25	25-30	NP-10
	21-27	Indurated--------	---	---	---	---	---	---	---	---	---
	27-60	Cinders----------	GP	A-1	0	5-10	0-5	0-5	0-5	---	NP
25*:											
Mespun----------	0-4	Loamy sand-------	SM, SP-SM	A-3, A-2	0	100	100	70-95	5-25	---	NP
	4-60	Fine sand, loamy fine sand, loamy sand.	SM, SP-SM	A-3, A-2	0	100	100	70-95	5-35	---	NP
Palma-----------	0-6	Sandy loam-------	SM	A-2, A-4	0	100	100	60-70	30-40	15-20	NP-5
	6-60	Fine sandy loam, sandy loam.	SM	A-4, A-2	0	100	100	65-75	30-40	15-25	NP-5
26--------------- Navajo	0-14	Clay-------------	CH	A-7	0	100	100	90-100	80-95	50-55	25-30
	14-60	Silty clay, clay	CH	A-7	0	100	100	90-100	80-95	55-60	30-40
27--------------- Palma	0-6	Sandy loam-------	SM	A-2, A-4	0	100	100	60-70	30-40	15-20	NP-5
	6-60	Fine sandy loam, sandy loam.	SM	A-4, A-2	0	100	100	65-75	30-40	15-25	NP-5
28--------------- Pastura	0-2	Gravelly loam----	CL, SC, GC	A-6	0	65-80	60-75	50-70	35-60	30-40	10-15
	2-11	Loam, clay loam, gravelly loam.	CL-ML, CL	A-4, A-6	0	75-95	65-90	60-80	50-70	25-35	5-15
	11	Indurated--------	---	---	---	---	---	---	---	---	---
29*:											
Paymaster-------	0-6	Sandy loam-------	SM	A-4, A-2	0	95-100	90-100	60-75	30-40	20-25	NP-5
	6-42	Loam, very fine sandy loam.	CL-ML	A-4	0	95-100	90-100	80-90	50-60	20-30	5-10
	42-60	Gravelly sandy loam, sandy loam.	SM	A-1, A-2	0	80-100	65-90	40-60	20-35	20-25	NP-5

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification Unified	Classification AASHTO	Frag- ments > 3 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
29*:											
Lynx	0-2	Loam	CL-ML, SM-SC	A-4	0	90-100	90-100	70-80	40-60	20-25	5-10
	2-60	Clay loam, loam, silt loam.	CL	A-6	0	95-100	95-100	80-90	60-75	30-40	10-20
30 Poley	0-4	Sandy loam	CL-ML, SM-SC	A-4	0	95-100	90-95	60-80	35-60	20-30	5-10
	4-10	Clay loam, sandy clay loam.	ML, CL	A-6	0	90-100	85-100	80-90	50-60	35-40	10-15
	10-22	Clay, clay loam	CL, CH	A-7	0	95-100	90-100	80-90	70-80	40-60	25-35
	22-60	Cobbly sandy loam, gravelly loam, very gravelly sandy loam.	GM, SM	A-2, A-1	10-30	55-75	50-70	40-50	20-35	15-20	NP-5
31 Poley	0-4	Gravelly loam	GM, SM	A-2, A-4	0	65-85	60-75	40-60	30-45	15-20	NP-5
	4-10	Clay loam, sandy clay loam.	ML, CL	A-6	0	90-100	85-100	80-90	50-60	35-40	10-15
	10-22	Clay, clay loam	CL, CH	A-7	0	95-100	90-100	80-90	70-80	40-60	25-35
	22-60	Cobbly sandy loam, gravelly loam, very gravelly sandy loam.	GM, SM	A-2, A-1	10-30	55-75	50-70	40-50	20-35	15-20	NP-5
32*:											
Poley	0-4	Gravelly loam	GM, SM	A-2, A-4	0	65-85	60-75	40-60	30-45	15-20	NP-5
	4-10	Clay loam, sandy clay loam.	ML, CL	A-6	0	90-100	85-100	80-90	50-60	35-40	10-15
	10-26	Clay, clay loam	CL, CH	A-7	0	95-100	90-100	80-90	70-80	40-60	25-35
	26-60	Cobbly sandy loam, gravelly loam, very gravelly sandy loam.	GM, SM	A-2, A-1	10-30	55-75	50-70	40-50	20-35	15-20	NP-5
Lynx	0-2	Loam	CL-ML, SM-SC	A-4	0	90-100	90-100	70-80	40-60	20-25	5-10
	2-60	Clay loam, loam, silt loam.	CL	A-6	0	95-100	95-100	80-90	60-75	30-40	10-20
33*:											
Poley	0-4	Gravelly loam	GM, SM	A-2, A-4	0	65-85	60-75	40-60	30-45	15-20	NP-5
	4-10	Clay loam, sandy clay loam.	ML, CL	A-6	0	90-100	85-100	80-90	50-60	35-40	10-15
	10-22	Clay, clay loam	CL, CH	A-7	0	95-100	90-100	80-90	70-80	40-60	25-35
	22-60	Cobbly sandy loam, gravelly loam, very gravelly sandy loam.	GM, SM	A-2, A-1	10-30	55-75	50-70	40-50	20-35	15-20	NP-5
Tusayan	0-3	Gravelly loam	SM-SC, GM-GC	A-4	0	65-75	60-70	55-65	35-50	20-30	5-10
	3-29	Gravelly loam, very gravelly loam, extremely gravelly loam.	GM-GC	A-2, A-1	0	25-50	20-50	15-40	10-35	20-30	5-10
	29	Unweathered bedrock.	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
34--------------- Purgatory	0-2	Gravelly fine sandy loam.	SM, GM	A-2	0	55-80	50-70	40-50	25-35	15-20	NP-5
	2-14	Sandy loam, fine sandy loam, loam.	SM	A-2, A-4	0	95-100	85-100	55-65	30-40	15-20	NP-5
	14-34	Clay loam--------	ML	A-6, A-7	0	100	80-90	70-80	55-70	35-45	10-15
	34	Weathered bedrock	---	---	---	---	---	---	---	---	---
35--------------- Quivera	0-3	Very gravelly loam.	GC	A-2	0	30-55	25-50	20-30	15-20	25-35	10-15
	3-28	Gravelly clay, gravelly clay loam.	GC, SC, CL, CH	A-7	0	55-80	50-75	45-70	35-60	40-55	20-30
	28-60	Very gravelly loam, very gravelly loamy sand, very gravelly clay loam.	GM, GM-GC, GP-GM	A-2, A-1	0	30-55	25-50	20-45	5-35	20-30	NP-10
36*. Riverwash											
37--------------- Rune	0-3	Silty clay loam	CL	A-6	0	100	100	80-90	70-80	35-40	15-20
	3-60	Clay, silty clay	CH	A-7	0	100	100	85-95	70-95	50-60	30-40
38*: Rune------------	0-3	Silty clay loam	CL	A-6	0	100	100	80-90	70-80	35-40	15-20
	3-60	Clay, silty clay	CH	A-7	0	100	100	85-95	70-95	50-60	30-40
Disterheff------	0-3	Cobbly sandy clay loam.	ML, CL	A-6	25-40	90-100	85-90	75-85	50-65	35-40	10-15
	3-25	Clay, gravelly clay loam, gravelly clay.	CH, CL	A-7	0	95-100	80-90	70-80	60-75	40-55	25-35
	25-60	Very cobbly clay loam, very gravelly clay loam.	CL-ML	A-6	25-30	75-100	65-90	55-75	50-60	35-40	10-15
39--------------- Servilleta	0-2	Fine sandy loam	SM, ML	A-4	0-5	95-100	90-100	70-80	40-70	20-25	NP-5
	2-17	Clay, clay loam	CL	A-7	0-5	90-100	85-100	80-90	70-80	40-50	20-35
	17-35	Gravelly clay loam, clay loam.	CL, SC, GC	A-6, A-7	0-5	60-80	50-75	45-75	35-60	35-45	15-20
	35	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
40*: Servilleta------	0-2	Fine sandy loam	SM, ML	A-4	0-5	95-100	90-100	70-80	40-70	20-25	NP-5
	2-17	Clay, clay loam	CL	A-7	0-5	90-100	85-100	80-90	70-80	40-50	20-35
	17-35	Gravelly clay loam, clay loam.	CL, SC, GC	A-6, A-7	0-5	60-80	50-75	45-75	35-60	35-45	15-20
	35	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Tusayan---------	0-3	Gravelly sandy loam.	SM	A-2, A-1	0	65-75	60-75	40-55	20-35	---	NP
	3-29	Very gravelly loam, extremely gravelly loam, gravelly loam.	GM-GC	A-2, A-1	0	25-70	20-60	15-45	10-35	20-30	5-10
	29	Unweathered bedrock.	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
41, 42*---------- Showlow	0-2	Gravelly fine sandy loam.	SC, CL	A-2, A-6	0	75-80	65-75	55-70	30-60	25-40	10-15
	2-27	Clay, gravelly clay loam, gravelly clay.	CL, CH	A-7	0	95-100	65-100	60-100	50-90	40-55	20-35
	27-60	Gravelly sandy clay loam, very gravelly clay loam, gravelly clay loam.	GC, SC	A-6	0	60-85	40-75	35-70	35-40	30-40	10-15
43-------------- Springerville	0-3	Cobbly clay------	CL, CH	A-7	25-35	95-100	90-95	85-95	80-90	45-65	25-45
	3-42	Silty clay, clay	CL, CH	A-7	0	95-100	95-100	90-100	80-95	45-65	25-45
	42	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
44-------------- Springerville	0-3	Very stony clay	CL, CH	A-7	50-70	95-100	90-95	85-95	80-90	45-65	25-45
	3-42	Clay, silty clay	CL, CH	A-7	0	95-100	95-100	90-100	80-95	45-65	25-45
	42	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
45*: Tajo------------	0-3	Gravelly loam----	GM-GC, GM, CL-ML, ML	A-4	0-10	65-75	60-75	50-70	40-55	25-35	5-10
	3-24	Clay loam, gravelly clay loam.	CL	A-6	0	90-95	75-90	70-90	60-70	30-40	10-15
	24-30	Cemented---------	---	---	---	---	---	---	---	---	---
	30-50	Very cobbly sandy loam.	SM	A-2	50-60	80-90	70-80	45-55	15-25	15-20	NP-5
	50	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Springerville---	0-4	Cobbly clay------	CL, CH	A-7	25-35	95-100	90-95	85-95	80-90	45-65	25-45
	4-42	Silty clay, clay	CL, CH	A-7	0	95-100	95-100	90-100	80-95	45-65	25-45
	42	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
46-------------- Tenorio	0-3	Very gravelly sandy loam.	GM, SM	A-1	0	50-60	40-50	25-35	10-20	15-20	NP-5
	3-16	Gravelly clay loam, gravelly loam, very gravelly sandy clay loam.	GC, SC	A-2, A-6	0	65-75	50-70	45-60	30-50	30-40	10-15
	16-60	Extremely gravelly sand, very gravelly loamy sand.	GW, GP	A-1	0	15-30	10-25	5-15	0-5	---	NP
47*: Thunderbird-----	0-2	Very cobbly clay loam.	CL	A-7, A-6	50-60	90-100	85-95	75-95	60-80	35-50	20-35
	2-24	Clay, clay loam	CL, CH	A-7	5-10	95-100	90-95	80-90	60-85	40-60	25-35
	24	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Cabezon---------	0-3	Stony clay loam	ML	A-7, A-6	25-35	85-95	80-90	70-80	55-70	35-45	10-15
	3-15	Clay, gravelly clay, cobbly clay.	CL, CH	A-7	10-30	75-95	70-90	60-80	55-75	40-60	25-40
	15	Unweathered bedrock.	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
48*:											
Thunderbird-----	0-2	Extremely stony clay loam.	ML	A-7	50-70	90-100	85-95	75-90	60-75	40-50	15-20
	2-24	Clay, clay loam.	CH	A-7	0-10	90-100	85-95	75-90	65-85	50-60	25-35
	24	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop.											
49*:											
Thunderbird-----	0-2	Very stony clay loam.	ML	A-7	50-70	90-100	85-95	75-90	60-75	40-50	15-20
	2-24	Clay, clay loam.	CH	A-7	0-10	90-100	85-95	75-90	65-85	50-60	25-35
	24	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Springerville---	0-3	Cobbly clay------	CL, CH	A-7	25-35	95-100	90-95	85-95	80-90	45-65	25-45
	3-42	Silty clay, clay	CL, CH	A-7	0	95-100	95-100	90-100	80-95	45-65	25-45
	42	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
50*. Torrifluvents											
51--------------- Tours	0-10	Silty clay loam, sandy clay loam.	CL	A-6	0	100	100	90-100	70-90	30-40	10-15
	10-60	Silty clay loam, silt loam, very fine sandy loam.	ML, CL	A-6	0	100	100	95-100	75-95	35-40	10-15
52*:											
Tours-----------	0-10	Fine sandy loam, silty clay loam.	SM	A-2, A-4	0	100	100	60-85	30-45	20-25	NP-5
	10-60	Silty clay loam, silt loam, very fine sandy loam.	ML, CL	A-6	0	100	100	95-100	75-95	35-40	10-15
Ives------------	0-3	Sandy loam-------	SM	A-2, A-4	0	100	95-100	55-70	30-40	15-20	NP-5
	3-60	Fine sandy loam, sandy loam, gravelly sandy loam.	SM	A-4	0	80-100	75-100	60-75	35-50	15-25	NP-5
53*:											
Tovar-----------	0-3	Very stony fine sandy loam.	SM, SM-SC	A-4	50-60	85-90	80-85	60-70	35-50	20-30	NP-5
	3-8	Flaggy sandy clay loam, flaggy clay loam.	SM, ML	A-6, A-7	20-35	85-90	80-85	70-85	45-60	35-45	10-15
	8-35	Flaggy clay, flaggy clay loam.	CL, CH	A-7	20-35	85-90	80-85	70-85	65-75	40-60	15-35
	35	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Tovar-----------	0-3	Fine sandy loam	SM	A-4	0-5	85-90	80-85	55-70	35-50	20-25	NP-5
	3-8	Flaggy sandy clay loam, flaggy clay loam.	SM, ML	A-6, A-7	20-35	85-90	80-85	70-85	45-60	35-45	10-15
	8-35	Flaggy clay, flaggy clay loam.	CL, CH	A-7	20-35	85-90	80-85	70-85	65-75	40-60	15-35
	35	Unweathered bedrock.	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
54*:											
Tovar-----------	0-3	Extremely stony fine sandy loam.	SM, SM-SC	A-4	50-60	85-90	80-85	60-70	35-50	20-30	NP-5
	3-8	Flaggy sandy clay loam, flaggy clay loam.	SM, ML	A-6, A-7	20-35	85-90	80-85	70-85	45-60	35-45	10-15
	8-35	Flaggy clay, flaggy clay loam.	CL, CH	A-7	20-35	85-90	80-85	70-85	65-75	40-60	15-35
	35	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Tovar-----------	0-3	Fine sandy loam	SM	A-4	0-5	85-90	80-85	55-70	35-50	20-25	NP-5
	3-8	Flaggy sandy clay loam, flaggy clay loam.	SM, ML	A-6, A-7	20-35	85-90	80-85	70-85	45-60	35-45	10-15
	8-35	Flaggy clay, flaggy clay loam.	CL, CH	A-7	20-35	85-90	80-85	70-85	65-75	40-60	15-35
	35	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
55*:											
Tusayan---------	0-10	Gravelly loam----	SM-SC, GM-GC	A-4	0	65-75	60-70	55-65	35-50	20-30	5-10
	10-29	Very gravelly loam, gravelly loam, extremely gravelly loam.	GM-GC	A-2, A-1	0	25-50	20-50	15-40	10-35	20-30	5-10
	29	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Lynx------------	0-2	Loam-------------	CL-ML, SM-SC	A-4	0	90-100	90-100	70-80	40-60	20-25	5-10
	2-60	Clay loam, loam, silt loam.	CL	A-6	0	95-100	95-100	80-90	60-75	30-40	10-20
56--------------- Tuweep	0-3	Very gravelly loam.	GM, GM-GC	A-1, A-2	0-10	30-50	20-50	15-45	10-35	20-30	NP-10
	3-34	Clay loam, silty clay loam.	CL	A-6	0-5	85-95	75-90	70-85	60-80	30-40	10-20
	34-60	Extremely stony loam.	CL-ML, SM-SC, GM-GC	A-4	75-80	70-90	70-85	60-70	40-60	20-30	5-10
57--------------- Valle	0-3	Gravelly silt loam.	GM-GC, SM-SC, CL-ML	A-2, A-4	0	60-85	50-75	35-65	30-60	20-30	5-10
	3-60	Very gravelly clay loam, gravelly loam.	GC	A-2, A-6	0	50-60	45-55	35-50	30-40	25-35	10-15
58--------------- Wilaha	0-5	Cindery loam-----	GM-GC, SM-SC	A-2, A-4	0	55-80	50-75	40-60	30-50	25-30	5-10
	5-14	Clay loam, cindery clay loam.	GC, SC, CL	A-6	0	70-90	65-85	60-85	40-65	35-40	15-20
	14-17	Very cindery loam.	GM-GC	A-1, A-2	0	35-50	30-50	25-35	20-30	25-30	5-10
	17-60	Cinders----------	GP	A-1	0	5-10	0-5	0-5	0-5	---	NP

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification Unified	Classification AASHTO	Frag- ments > 3 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
59*:											
Wilaha	0-5	Cindery loam	GM-GC, SM-SC	A-2, A-4	0	55-80	50-75	40-60	30-50	25-30	5-10
	5-14	Clay loam, cindery clay loam.	GC, SC, CL	A-6	0	70-90	65-85	60-85	40-65	35-40	15-20
	14-17	Very cindery loam.	GM-GC	A-1, A-2	0	35-50	30-50	25-35	20-30	25-30	5-10
	17-60	Cinders	GP	A-1	0	5-10	0-5	0-5	0-5	---	NP
Wukoki	0-10	Very cindery loam.	GM, GM-GC	A-1, A-2	0	25-50	20-50	20-35	15-25	25-30	NP-10
	10-18	Very cindery loam, extremely cindery loam.	GM, GM-GC	A-1, A-2	0	25-50	20-50	20-35	15-25	25-30	NP-10
	18-65	Cinders	GP	A-1	0	5-10	0-5	0-5	0-5	---	NP
60 Winona	0-2	Gravelly loam	SM-SC, SM	A-2, A-4	0	65-80	60-75	50-60	25-40	20-30	NP-10
	2-15	Extremely cobbly, loam, very cobbly sandy loam, very gravelly loam.	GM-GC, GM, SM-SC, SM	A-2, A-1	40-60	35-65	30-60	25-45	15-30	20-30	NP-10
	15	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
61 Winona	0-2	Stony loam	CL-ML, ML, SM-SC, SM	A-2, A-4	25-50	80-90	75-85	50-70	30-55	20-30	NP-10
	2-15	Extremely cobbly, loam, very cobbly sandy loam, very gravelly loam.	GM-GC, GM	A-2	40-60	35-65	30-60	25-45	15-30	20-30	NP-10
	15	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
62*:											
Winona	0-2	Gravelly loam	SM-SC, SM	A-2, A-4	0	65-80	60-75	50-60	25-40	20-30	NP-10
	2-15	Extremely cobbly, loam, very cobbly sandy loam, very gravelly loam.	GM-GC, GM, SM-SC, SM	A-2, A-1	40-60	35-65	30-60	25-45	15-30	20-30	NP-10
	15	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Boysag	0-3	Gravelly loam	GM, SM, GM-GC, SM-SC	A-4	0	65-80	60-75	55-65	40-50	20-30	NP-10
	3-13	Clay loam, clay, gravelly clay loam.	CL	A-7	0	90-100	70-85	70-80	60-70	40-50	15-25
	13-16	Very cobbly loam, gravelly loam, very gravelly loam.	SM-SC, GM-GC	A-4, A-2	20-40	60-80	50-70	45-60	30-50	20-25	5-10
	16	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
63*:											
Winona	0-2	Stony sandy loam	CL-ML, ML SM-SC, SM	A-2, A-4	25-50	80-90	75-85	50-70	30-55	20-30	NP-10
	2-15	Extremely cobbly, loam, very cobbly sandy loam, very gravelly loam.	GM-GC, GM	A-2,	40-60	35-65	30-60	25-45	15-30	20-30	NP-10
	15	Unweathered bedrock.	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
63*:											
Epikom	0-3	Fine sandy loam	SM	A-4	0	95-100	90-100	60-85	35-45	20-25	NP-5
	3-15	Sandy loam, loam, gravelly loam.	SM, SM-SC	A-2, A-4	0-5	65-100	60-80	45-65	25-45	20-25	NP-10
	15	Unweathered bedrock.	---	---	---	---	---	---	---	---	
64*, 65*:											
Winona	0-2	Gravelly loam	SM-SC, SM	A-2, A-4	0	65-80	60-75	50-60	25-40	20-30	NP-10
	2-15	Extremely cobbly loam, very cobbly sandy loam, very gravelly loam.	GM-GC, GM SM-SC, SM	A-2, A-1	40-60	35-65	30-60	25-45	15-30	20-30	NP-10
	15	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop.											
66*:											
Winona	0-2	Gravelly sandy loam.	SM-SC, SM	A-2, A-4	0	65-80	60-75	50-60	25-40	20-30	NP-10
	2-15	Extremely cobbly loam, very cobbly sandy loam, very gravelly loam.	GM-GC, GM, SM-SC, SM	A-2, A-1	40-60	35-65	30-60	25-45	15-30	20-30	NP-10
	15	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Tusayan	0-3	Gravelly sandy loam.	SM	A-2, A-1	0	65-75	60-75	40-55	20-35	---	NP
	3-29	Very gravelly loam, gravelly loam, extremely gravelly loam.	GM-GC	A-2, A-1	0	25-50	20-50	15-40	10-35	20-30	5-10
	29	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
67*:											
Wukoki	0-10	Very cindery loam.	GM, GM-GC	A-1, A-2	0	25-50	20-50	20-35	15-25	25-30	NP-10
	10-18	Very cindery loam.	GM, GM-GC	A-1, A-2	0	25-50	20-50	20-35	15-25	25-30	NP-10
	18-60	Cinders	GP	A-1	0	5-10	0-5	0-5	0-5	---	NP
Rock outcrop.											
68*:											
Wukoki	0-10	Very cindery loam.	GM, GM-GC	A-1, A-2	0	25-50	20-50	20-35	15-25	25-30	NP-10
	10-18	Very cindery loam.	GM, GM-GC	A-1, A-2	0	25-50	20-50	20-35	15-25	25-30	NP-10
	18-60	Cinders	GP	A-1	0	5-10	0-5	0-5	0-5	---	NP
Wupatki	0-6	Very cindery loam.	GM-GC	A-1, A-2	0	25-50	20-50	20-35	15-25	25-30	5-10
	6-16	Very cindery loam.	GM-GC	A-1, A-2	0	25-50	20-50	20-35	15-25	25-30	5-10
	16-20	Indurated	---	---	---	---	---	---	---	---	---
	20-60	Cinders	GP	A-1	0	5-10	0-5	0-5	0-5	---	NP

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
69*:											
Wupatki----------	0-6	Very cindery loam.	GM-GC	A-1, A-2	0	25-50	20-50	20-35	15-25	25-30	5-10
	6-16	Very cindery loam.	GM-GC	A-1, A-2	0	25-50	20-50	20-35	15-25	25-30	5-10
	16-20	Indurated--------	---	---	---	---	---	---	---	---	---
	20-60	Cinders----------	GP	A-1	0	5-10	0-5	0-5	0-5	---	NP
Wukoki----------	0-10	Very cindery loam.	GM, GM-GC	A-1, A-2	0	25-50	20-50	20-35	15-25	25-30	NP-10
	10-18	Very cindery loam.	GM, GM-GC	A-1, A-2	0	25-50	20-50	20-35	15-25	25-30	NP-10
	18-60	Cinders----------	GP	A-1	0	5-10	0-5	0-5	0-5	---	NP
70--------------- Ziegler	0-3	Gravelly loam----	GM, SM, ML	A-6	0	65-80	60-75	50-70	35-60	35-40	10-15
	3-15	Clay-------------	CH	A-7	0	85-100	80-90	75-85	60-75	50-60	25-35
	15-24	Very cindery clay loam, clay	GM	A-2, A-6	0	35-55	30-50	20-50	20-40	35-40	10-15
	24-60	Cinders----------	GP	A-1	0	5-10	0-5	0-5	0-5	---	NP
71*:											
Ziegler---------	0-3	Gravelly loam----	GM, SM, ML	A-6	0	65-80	60-75	50-70	35-60	35-40	10-15
	3-15	Clay-------------	CH	A-7	0	85-100	80-90	75-85	60-75	50-60	25-35
	15-24	Very cindery clay loam, clay.	GM	A-2, A-6	0	35-55	30-50	20-50	20-40	35-40	10-15
	24-60	Cinders----------	GP	A-1	0	5-10	0-5	0-5	0-5	---	NP
Cross-----------	0-3	Stony clay loam	ML, CL	A-6	25-50	85-90	80-85	75-85	60-70	35-40	10-15
	3-14	Clay, clay loam	CL, CH	A-7	0	85-100	80-90	75-85	60-75	40-55	20-30
	14-19	Cobbly clay loam	CL	A-7	25-35	90-100	80-90	75-85	55-70	40-45	15-20
	19	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
72*:											
Ziegler---------	0-3	Gravelly loam----	GM, SM, ML	A-6	0	65-80	60-75	50-70	35-60	35-40	10-15
	3-15	Clay-------------	CH	A-7	0	85-100	80-90	75-85	60-75	50-60	25-35
	15-24	Very cindery clay loam, clay.	GM	A-2, A-6	0	35-55	30-50	20-50	20-40	35-40	10-15
	24-60	Cinders----------	GP	A-1	0	5-10	0-5	0-5	0-5	---	NP
Wilaha----------	0-5	Cindery loam-----	GM-GC, SM-SC	A-2, A-4	0	55-80	50-75	40-60	30-50	25-30	5-10
	5-14	Clay loam, cindery clay loam.	GC, SC, CL	A-6	0	70-90	65-85	60-85	40-65	35-40	15-20
	14-17	Very cindery loam.	GM-GC	A-1, A-2	0	35-50	30-50	25-35	20-30	25-30	5-10
	17-60	Cinders----------	GP	A-1	0	5-10	0-5	0-5	0-5	---	NP

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

[The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated]

Soil name and map symbol	Depth	Clay	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group
	In	Pct	In/hr	In/in	pH	Mmhos/cm				
1 Ashfork	0-2	30-35	0.2-0.6	0.13-0.15	7.9-8.4	<2	Moderate	0.20	2	8
	2-17	35-55	0.06-0.2	0.15-0.18	7.9-9.0	<2	High	0.28		
	17-30	25-35	0.6-2.0	0.11-0.13	7.9-9.0	<2	Low	0.32		
	30	---	---	---	---	---	---	---		
2 Aut	0-7	15-25	0.6-2.0	0.14-0.16	7.9-8.4	<2	Low	0.20	2	8
	7-26	18-25	0.6-2.0	0.12-0.15	7.9-8.4	<2	Low	0.10		
	26-38	18-25	0.6-2.0	0.12-0.15	7.9-8.4	<2	Low	0.10		
	38	---	---	---	---	---	---	---		
3*:										
Aut	0-7	15-25	0.6-2.0	0.14-0.16	7.9-8.4	<2	Low	0.20	2	8
	7-26	18-25	0.6-2.0	0.12-0.15	7.9-8.4	<2	Low	0.10		
	26-38	18-25	0.6-2.0	0.12-0.15	7.9-8.4	<2	Low	0.10		
	38	---	---	---	---	---	---	---		
Cross	0-3	30-35	0.2-0.6	0.10-0.15	6.6-8.4	<2	Moderate	0.05	1	8
	3-14	35-55	0.06-0.2	0.14-0.17	7.4-8.4	<2	High	0.28		
	14-19	35-40	0.06-0.2	0.16-0.18	7.4-8.4	<2	Moderate	0.17		
	19	---	---	---	---	---	---	---		
4*:										
Aut	0-7	15-25	0.6-2.0	0.14-0.16	7.9-8.4	<2	Low	0.20	2	8
	7-26	18-25	0.6-2.0	0.12-0.15	7.9-8.4	<2	Low	0.10		
	26-38	18-25	0.6-2.0	0.12-0.15	7.9-8.4	<2	Low	0.10		
	38	---	---	---	---	---	---	---		
Lynx	0-2	8-20	0.2-0.6	0.14-0.16	6.6-8.4	<2	Low	0.28	5	5
	2-60	18-35	0.2-0.6	0.18-0.20	6.6-8.4	<2	Moderate	0.32		
5*:										
Badland.										
Torriorthents.										
6*:										
Boquillas	0-3	15-25	0.6-2.0	0.12-0.15	6.6-7.8	<2	Low	0.17	2	8
	3-23	35-45	0.06-0.2	0.12-0.19	6.6-7.8	<2	High	0.20		
	23-38	30-40	0.2-0.6	0.10-0.14	6.6-7.8	<2	Moderate	0.10		
	38	---	---	---	---	---	---	---		
Seligman	0-3	10-35	0.2-0.6	0.10-0.17	6.6-7.8	<2	Moderate	0.10	1	8
	3-15	35-55	0.06-0.2	0.12-0.20	6.6-7.8	<2	High	0.15		
	15	---	---	---	---	---	---	---		
7 Clovis	0-5	5-10	6.0-20	0.06-0.08	6.6-7.8	<2	Low	0.15	5	2
	5-17	27-35	0.6-2.0	0.15-0.20	6.6-7.8	<2	Moderate	0.28		
	17-60	10-20	0.6-6.0	0.14-0.17	7.9-8.4	<2	Low	0.28		
8*:										
Cross	0-3	30-35	0.2-0.6	0.13-0.18	6.6-8.4	<2	Moderate	0.15	1	8
	3-14	35-55	0.06-0.2	0.14-0.17	7.4-8.4	<2	High	0.28		
	14-19	35-40	0.06-0.2	0.16-0.18	7.4-8.4	<2	Moderate	0.17		
	19	---	---	---	---	---	---	---		
Apache	0-8	25-35	0.6-2.0	0.12-0.16	7.9-8.4	<2	Low	0.15	1	8
	8-18	15-25	0.6-2.0	0.12-0.15	7.9-8.4	<2	Low	0.15		
	18	---	---	---	---	---	---	---		
9*:										
Daze	0-12	10-20	0.6-2.0	0.13-0.15	6.6-7.3	<2	Low	0.15	1	8
	12-19	35-55	0.06-0.2	0.08-0.12	7.4-8.4	<2	High	0.17		
	19	---	---	---	---	---	---	---		

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodi-bility group
	In	Pct	In/hr	In/in	pH	Mmhos/cm				
9*:										
Deama-----------	0-7	18-25	0.6-2.0	0.12-0.14	7.9-8.4	<2	Low----------	0.17	1	8
	7-19	18-25	0.6-2.0	0.05-0.08	7.9-8.4	<2	Low----------	0.05		
	19	---	---	---	---	---	-------------	----		
10--------------- Deama	0-7	18-25	0.6-2.0	0.12-0.14	7.9-8.4	<2	Low----------	0.17	1	8
	7-19	18-25	0.6-2.0	0.05-0.08	7.9-8.4	<2	Low----------	0.05		
	19	---	---	---	---	---	-------------	----		
11--------------- Deama	0-7	18-25	0.6-2.0	0.07-0.10	7.9-8.4	<2	Low----------	0.10	1	8
	7-19	18-25	0.6-2.0	0.05-0.08	7.9-8.4	<2	Low----------	0.05		
	19	---	---	---	---	---	-------------	----		
12*:										
Deama-----------	0-7	18-25	0.6-2.0	0.07-0.10	7.9-8.4	<2	Low----------	0.10	1	8
	7-19	18-25	0.6-2.0	0.05-0.08	7.9-8.4	<2	Low----------	0.05		
	19	---	---	---	---	---	-------------	----		
Rock outcrop.										
13*:										
Deama-----------	0-7	18-25	0.6-2.0	0.12-0.14	7.9-8.4	<2	Low----------	0.17	1	8
	7-19	18-25	0.6-2.0	0.05-0.08	7.9-8.4	<2	Low----------	0.05		
	19	---	---	---	---	---	-------------	----		
Toqui-----------	0-3	8-20	2.0-6.0	0.13-0.15	6.1-7.3	<2	Low----------	0.24	1	8
	3-15	35-50	0.06-0.2	0.16-0.21	6.6-8.4	<2	High---------	0.15		
	15-19	25-35	0.6-2.0	0.10-0.15	7.9-8.4	<2	Moderate-----	0.05		
	19	---	---	---	---	---	-------------	----		
14*:										
Deama-----------	0-7	18-25	0.6-2.0	0.12-0.14	7.9-8.4	<2	Low----------	0.17	1	8
	7-19	18-25	0.6-2.0	0.05-0.08	7.9-8.4	<2	Low----------	0.05		
	19	---	---	---	---	---	-------------	----		
Tovar-----------	0-3	15-25	0.6-2.0	0.09-0.12	6.1-7.8	<2	Low----------	0.10	2	8
	3-8	28-40	0.2-0.6	0.11-0.15	6.6-8.4	<2	Moderate-----	0.15		
	8-35	35-55	0.06-0.2	0.11-0.15	6.6-8.4	<2	High---------	0.10		
	35	---	---	---	---	---	-------------	----		
15--------------- Disterheff	0-6	30-35	0.2-0.6	0.13-0.15	6.6-8.4	<2	Moderate-----	0.15	5	8
	6-24	35-50	0.06-0.2	0.14-0.16	7.4-8.4	<2	High---------	0.15		
	24-60	30-35	0.2-0.6	0.13-0.15	7.4-8.4	<2	Moderate-----	0.15		
16*:										
Disterheff------	0-6	15-25	0.2-0.6	0.12-0.14	6.6-8.4	<2	Low----------	,17	5	8
	6-24	35-50	0.06-0.2	0.14-0.16	7.4-8.4	<2	High---------	0.15		
	24-60	30-35	0.2-0.6	0.13-0.15	7.4-8.4	<2	Moderate-----	0.15		
Kopie-----------	0-3	8-15	2.0-6.0	0.11-0.13	7.9-8.4	<2	Low----------	0.17	1	8
	3-15	15-25	0.6-2.0	0.14-0.18	7.9-8.4	<2	Low----------	0.15		
	15	---	---	---	---	---	-------------	----		
17--------------- Epikom	0-8	5-10	6.0-20	0.03-0.05	7.4-8.4	<4	Low----------	0.10	1	8
	8-13	15-20	0.6-2.0	0.10-0.14	7.9-9.0	<4	Low----------	0.32		
	13	---	---	---	---	---	-------------	----		
18*:										
Epikom----------	0-3	10-20	2.0-6.0	0.13-0.15	7.4-8.4	<4	Low----------	0.28	1	3
	3-15	15-20	0.6-2.0	0.11-0.13	7.9-9.0	<4	Low----------	0.32		
	15	---	---	---	---	---	-------------	----		
Epikom----------	0-3	10-20	2.0-6.0	0.11-0.13	7.4-8.4	<4	Low----------	0.15	1	3
	3-15	15-20	0.6-2.0	0.10-0.14	7.9-9.0	<4	Low----------	0.32		
	15	---	---	---	---	---	-------------	----		

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group
	In	Pct	In/hr	In/in	pH	Mmhos/cm				
19*:										
Epikom----------	0-3	10-20	2.0-6.0	0.11-0.13	7.4-8.4	<4	Low----------	0.15	1	3
	3-15	15-20	0.6-2.0	0.10-0.14	7.9-9.0	<4	Low----------	0.32		
	15	---	---	---	---	---	-------------	----		
Rock outcrop.										
20*:										
Faraway---------	0-7	10-15	0.6-2.0	0.08-0.12	6.6-7.8	<2	Low----------	0.05	1	8
	7-13	10-15	0.6-2.0	0.08-0.12	6.6-7.8	<2	Low----------	0.05		
	13	---	---	---	---	---	-------------	----		
Rock outcrop.										
21*:										
Keeseha---------	0-4	15-20	2.0-6.0	0.09-0.12	6.6-7.8	<2	Low----------	0.15	5	3
	4-13	40-50	0.2-0.6	0.12-0.16	7.4-8.4	<2	High---------	0.17		
	13-20	20-30	0.6-2.0	0.12-0.14	7.9-8.4	<2	Low----------	0.17		
	20-60	15-25	6.0-20	0.05-0.08	7.9-8.4	<2	Low----------	0.02		
Poley-----------	0-4	15-25	2.0-6.0	0.08-0.15	6.1-7.3	<2	Low----------	0.15	5	3
	4-10	30-35	0.2-0.6	0.14-0.19	7.4-8.4	<2	Moderate-----	0.32		
	10-22	35-55	0.06-0.2	0.14-0.16	7.4-8.4	<2	High---------	0.28		
	22-40	20-30	0.2-0.6	0.14-0.16	7.4-8.4	<2	Moderate-----	0.28		
	40-60	10-15	0.6-2.0	0.07-0.11	7.9-8.4	<2	Low----------	0.15		
22*:										
Kopie-----------	0-2	8-15	2.0-6.0	0.11-0.13	7.9-8.4	<2	Low----------	0.17	1	8
	2-6	15-25	0.6-2.0	0.16-0.18	7.9-8.4	<2	Low----------	0.28		
	6-14	15-25	0.6-2.0	0.14-0.18	7.9-8.4	<2	Low----------	0.15		
	14	---	---	---	---	---	-------------	----		
Servilleta------	0-2	10-15	0.6-2.0	0.08-0.15	6.6-8.4	<2	Low----------	0.43	2	3
	2-17	35-50	0.06-0.2	0.14-0.16	6.6-8.4	<2	High---------	0.32		
	17-34	30-40	0.2-0.6	0.14-0.18	7.9-8.4	<2	Moderate-----	0.32		
	34	---	---	---	---	---	-------------	----		
23*. Lava flows										
24*:										
Lomaki----------	0-3	20-25	0.6-2.0	0.05-0.08	7.9-8.4	<2	Low----------	0.05	2	8
	3-24	20-25	0.6-2.0	0.05-0.08	7.9-8.4	<2	Low----------	0.10		
	24-60	0-1	>20	0.03-0.05	7.9-8.4	<2	Low----------	0.02		
Nalaki----------	0-10	20-25	0.6-2.0	0.05-0.08	7.9-8.4	<2	Low----------	0.10	2	8
	10-21	20-27	0.6-2.0	0.05-0.08	7.9-8.4	<2	Low----------	0.05		
	21-27	---	---	---	---	<2	-------------	----		
	27-60	---	>20	0.03-0.05	7.9-8.4	<2	Low----------	0.02		
25*:										
Mespun----------	0-4	3-8	>20	0.05-0.08	7.4-8.4	<2	Low----------	0.15	5	2
	4-60	3-8	6.0-20	0.05-0.09	7.4-8.4	<2	Low----------	0.15		
Palma-----------	0-6	10-20	2.0-6.0	0.13-0.15	6.6-8.4	<2	Low----------	0.17	5	3
	6-60	10-20	2.0-6.0	0.13-0.17	6.6-8.4	<2	Low----------	0.17		
26--------------- Navajo	0-14	45-50	<0.06	0.14-0.16	7.9-8.4	<4	High---------	0.20	5	4
	14-60	50-55	<0.06	0.14-0.16	7.9-8.4	<4	High---------	0.20		
27--------------- Palma	0-6	10-20	2.0-6.0	0.13-0.15	6.6-8.4	<2	Low----------	0.17	5	3
	6-60	10-20	2.0-6.0	0.13-0.17	6.6-8.4	<2	Low----------	0.28		
28--------------- Pastura	0-2	25-35	0.6-2.0	0.12-0.18	7.9-8.4	<2	Moderate-----	0.20	1	8
	2-11	20-30	0.6-2.0	0.12-0.18	7.9-8.4	<2	Moderate-----	0.20		
	11	---	---	---	---	---	-------------	----		

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group
	In	Pct	In/hr	In/in	pH	Mmhos/cm				
29*:										
Paymaster--------	0-6	10-15	0.6-2.0	0.11-0.13	6.6-8.4	<2	Low-----------	0.17	5	3
	6-42	8-18	0.6-2.0	0.14-0.16	6.6-8.4	<2	Low-----------	0.28		
	42-60	10-15	2.0-6.0	0.08-0.10	6.6-8.4	<2	Low-----------	0.15		
Lynx-------------	0-2	8-20	0.2-0.6	0.14-0.16	6.6-8.4	<2	Low-----------	0.28	5	5
	2-60	18-35	0.2-0.6	0.18-0.20	6.6-8.4	<2	Moderate------	0.32		
30---------------- Poley	0-4	15-25	0.6-2.0	0.13-0.16	6.1-7.3	<2	Low-----------	0.17	5	3
	4-10	30-35	0.2-0.6	0.14-0.19	7.4-8.4	<2	Moderate------	0.32		
	10-22	35-55	0.06-0.2	0.14-0.16	7.4-8.4	<2	High----------	0.28		
	22-60	10-15	0.6-2.0	0.07-0.11	7.9-8.4	<2	Low-----------	0.15		
31---------------- Poley	0-4	15-25	2.0-6.0	0.08-0.15	6.1-7.3	<2	Low-----------	0.24	5	5
	4-10	30-35	0.2-0.6	0.14-0.19	7.4-8.4	<2	Moderate------	0.32		
	10-22	35-55	0.06-0.2	0.14-0.16	7.4-8.4	<2	High----------	0.28		
	22-60	10-15	0.6-2.0	0.07-0.11	7.9-8.4	<2	Low-----------	0.15		
32*:										
Poley------------	0-4	15-25	2.0-6.0	0.08-0.15	6.1-7.3	<2	Low-----------	0.24	5	5
	4-10	30-35	0.2-0.6	0.14-0.19	7.4-8.4	<2	Moderate------	0.32		
	10-26	35-55	0.06-0.2	0.14-0.16	7.4-8.4	<2	High----------	0.28		
	26-60	10-15	0.6-2.0	0.07-0.11	7.9-8.4	<2	Low-----------	0.15		
Lynx-------------	0-2	8-20	0.2-0.6	0.14-0.16	6.6-8.4	<2	Low-----------	0.28	5	5
	2-60	18-35	0.2-0.6	0.18-0.20	6.6-8.4	<2	Moderate------	0.32		
33*:										
Poley------------	0-4	15-25	2.0-6.0	0.08-0.15	6.1-7.3	<2	Low-----------	0.24	5	5
	4-10	30-35	0.2-0.6	0.14-0.19	7.4-8.4	<2	Moderate------	0.32		
	10-22	35-55	0.06-0.2	0.14-0.16	7.4-8.4	<2	High----------	0.28		
	22-60	10-15	0.6-2.0	0.07-0.11	7.9-8.4	<2	Low-----------	0.15		
Tusayan----------	0-3	15-20	0.6-2.0	0.11-0.13	7.9-8.4	<2	Low-----------	0.20	2	8
	3-29	18-30	0.6-2.0	0.05-0.07	7.9-8.4	<2	Low-----------	0.10		
	29	---	---	---	---	---	--------------	----		
34---------------- Purgatory	0-2	10-15	0.6-2.0	0.08-0.12	7.9-8.4	<2	Low-----------	0.28	2	3
	2-14	10-15	0.6-2.0	0.12-0.16	7.9-8.4	<2	Low-----------	0.37		
	14-34	30-35	0.6-2.0	0.19-0.21	7.9-8.4	<2	Moderate------	0.37		
	34	---	---	---	---	---	--------------	----		
35---------------- Quivera	0-3	20-30	0.6-2.0	0.05-0.07	6.6-7.3	<2	Low-----------	0.10	5	8
	3-28	35-50	0.06-0.2	0.11-0.13	6.6-8.4	<2	High----------	0.10		
	28-60	10-30	0.6-2.0	0.06-0.09	7.9-8.4	<2	Low-----------	0.05		
36*. Riverwash										
37---------------- Rune	0-3	30-40	0.2-0.6	0.19-0.21	7.9-8.4	<2	Moderate------	0.32	5	4L
	3-60	45-55	0.06-0.2	0.14-0.16	7.9-8.4	<2	High----------	0.32		
38*:										
Rune-------------	0-3	30-40	0.2-0.6	0.19-0.21	7.9-8.4	<2	Moderate------	0.32	5	4L
	3-60	45-55	0.06-0.2	0.14-0.16	7.9-8.4	<2	High----------	0.32		
Disterheff-------	0-3	30-35	0.2-0.6	0.13-0.15	6.6-8.4	<2	Moderate------	0.15	5	8
	3-25	35-50	0.06-0.2	0.14-0.16	7.4-8.4	<2	High----------	0.15		
	25-60	30-35	0.2-0.6	0.13-0.15	7.4-8.4	<2	Moderate------	0.15		
39---------------- Servilleta	0-2	10-15	0.6-2.0	0.08-0.15	6.6-8.4	<2	Low-----------	0.43	2	3
	2-17	35-50	0.06-0.2	0.14-0.16	6.6-8.4	<2	High----------	0.32		
	17-35	30-40	0.2-0.6	0.14-0.18	7.9-8.4	<2	Moderate------	0.32		
	35	---	---	---	---	---	--------------	----		

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group
	In	Pct	In/hr	In/in	pH	Mmhos/cm				
40*:										
Servilleta	0-2	10-15	0.6-2.0	0.08-0.15	6.6-8.4	<2	Low	0.43	2	3
	2-17	35-50	0.06-0.2	0.14-0.16	6.6-8.4	<2	High	0.32		
	17-35	30-40	0.2-0.6	0.14-0.18	7.9-8.4	<2	Moderate	0.32		
	35	---	---	---	---	---	---	---		
Tusayan	0-3	8-13	2.0-6.0	0.07-0.09	7.9-8.4	<2	Low	0.17	2	8
	3-29	18-30	0.6-2.0	0.05-0.07	7.9-8.4	<2	Low	0.10		
	29	---	---	---	---	---	---	---		
41, 42* Showlow	0-2	20-35	0.2-0.6	0.12-0.14	6.6-8.4	<2	Moderate	0.24	5	8
	2-27	35-55	0.06-0.2	0.15-0.19	6.6-8.4	<2	High	0.24		
	27-60	25-35	0.2-0.6	0.10-0.15	7.4-8.4	<2	Moderate	0.32		
43 Springerville	0-3	40-60	0.06-0.2	0.09-0.12	7.4-8.4	<2	High	0.05	3	8
	3-42	40-60	<0.06	0.15-0.17	7.4-8.4	<2	High	0.28		
	42	---	---	---	---	---	---	---		
44 Springerville	0-3	40-60	0.06-0.2	0.10-0.14	7.4-8.4	<2	High	0.20	3	8
	3-42	40-60	<0.06	0.15-0.17	7.4-8.4	<2	High	0.20		
	42	---	---	---	---	---	---	---		
45*:										
Tajo	0-3	20-30	0.6-2.0	0.14-0.16	7.9-8.4	<2	Low	0.17	2	8
	3-24	28-35	0.2-0.6	0.19-0.21	7.9-8.4	<2	Low	0.32		
	24-30	---	---	---	---	---	---	---		
	30-50	10-15	2.0-6.0	0.07-0.08	7.9-8.4	<2	Low	0.05		
	50	---	---	---	---	---	---	---		
Springerville	0-4	40-60	0.06-0.2	0.09-0.12	7.4-8.4	<2	High	0.05	3	8
	4-42	40-60	<0.06	0.15-0.17	7.4-8.4	<2	High	0.28		
	42	---	---	---	---	---	---	---		
46 Tenorio	0-3	5-10	0.6-2.0	0.03-0.05	6.1-7.3	<2	Low	0.05	5	8
	3-16	25-35	0.2-0.6	0.13-0.16	7.4-8.4	<2	Moderate	0.10		
	16-60	1-5	>20.0	0.01-0.02	7.4-8.4	<2	Low	0.02		
47*:										
Thunderbird	0-2	30-55	0.2-0.6	0.08-0.15	6.6-7.8	<2	High	0.05	2	8
	2-24	40-55	0.06-0.2	0.12-0.18	7.9-8.4	<2	High	0.24		
	24	---	---	---	---	---	---	---		
Cabezon	0-3	30-40	0.06-0.2	0.05-0.10	7.4-7.8	<2	Moderate	0.17	1	8
	3-15	35-60	0.06-0.2	0.12-0.14	7.4-7.8	<2	High	0.24		
	15	---	---	---	---	---	---	---		
48*:										
Thunderbird	0-2	35-40	0.2-0.6	0.10-0.15	6.6-7.8	<2	Moderate	0.05	2	8
	2-24	45-55	0.06-0.2	0.13-0.15	7.9-8.4	<2	High	0.28		
	24	---	---	---	---	---	---	---		
Rock outcrop.										
49*:										
Thunderbird	0-2	35-40	0.2-0.6	0.10-0.15	6.6-7.8	<2	Moderate	0.05	2	8
	2-24	45-55	0.06-0.2	0.13-0.15	7.9-8.4	<2	High	0.28		
	24	---	---	---	---	---	---	---		
Springerville	0-3	40-60	0.06-0.2	0.09-0.12	7.4-8.4	<2	High	0.05	2	8
	3-42	40-60	<0.06	0.15-0.17	7.4-8.4	<2	High	0.28		
	42	---	---	---	---	---	---	---		
50*. Torrifluvents										
51 Tours	0-10	25-35	0.2-0.6	0.19-0.21	7.4-8.4	<4	Moderate	0.37	5	4L
	10-60	18-35	0.2-0.6	0.19-0.21	7.4-8.4	<4	Moderate	0.37		
52*:										
Tours	0-10	10-15	0.6-2.0	0.11-0.15	7.4-8.4	<4	Low	0.24	5	3
	10-60	18-35	0.2-0.6	0.19-0.21	7.4-8.4	<4	Moderate	0.37		

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group
	In	Pct	In/hr	In/in	pH	Mmhos/cm				
52*:										
Ives------------	0-3	10-15	2.0-6.0	0.11-0.13	7.4-8.4	<2	Low----------	0.24	5	3
	3-60	10-15	0.6-2.0	0.12-0.14	7.4-8.4	<2	Low----------	0.24		
53*, 54*:										
Tovar-----------	0-3	15-25	0.6-2.0	0.08-0.11	6.1-7.8	<2	Low----------	0.05	2	8
	3-8	28-40	0.2-0.6	0.11-0.15	6.6-8.4	<2	Moderate-----	0.15		
	8-35	35-55	0.06-0.2	0.11-0.15	6.6-8.4	<2	High---------	0.10		
	35	---	---	---	---	---	-------------	----		
Tovar-----------	0-3	15-20	2.0-6.0	0.12-0.14	6.1-7.8	<2	Low----------	0.24	2	3
	3-8	28-40	0.2-0.6	0.11-0.15	6.6-8.4	<2	Moderate-----	0.15		
	8-35	35-55	0.06-0.2	0.11-0.15	6.6-8.4	<2	High---------	0.10		
	35	---	---	---	---	---	-------------	----		
55*:										
Tusayan---------	0-10	15-20	0.6-2.0	0.11-0.13	7.9-8.4	<2	Low----------	0.20	2	8
	10-29	18-30	0.6-2.0	0.05-0.07	7.9-8.4	<2	Low----------	0.10		
	29	---	---	---	---	---	-------------	----		
Lynx------------	0-2	8-20	0.2-0.6	0.14-0.16	6.6-8.4	<2	Low----------	0.28	5	5
	2-60	18-35	0.2-0.6	0.18-0.20	6.6-8.4	<2	Moderate-----	0.32		
56--------------- Tuweep	0-3	18-25	0.6-2.0	0.05-0.08	7.9-8.4	<2	Low----------	0.10	5	8
	3-34	28-34	0.2-0.6	0.17-0.19	7.9-8.4	<2	Moderate-----	0.32		
	34-60	15-20	0.6-2.0	0.04-0.06	7.9-8.4	<2	Low----------	0.10		
57--------------- Valle	0-3	15-25	0.6-2.0	0.10-0.15	5.6-7.3	<2	Low----------	0.24	5	8
	3-60	20-30	0.6-2.0	0.10-0.14	6.6-7.8	<2	Moderate-----	0.10		
58--------------- Wilaha	0-5	20-25	0.6-2.0	0.10-0.14	7.4-8.4	<2	Low----------	0.24	2	8
	5-14	28-35	0.2-0.6	0.15-0.19	7.4-8.4	<2	Moderate-----	0.28		
	14-17	20-25	0.2-0.6	0.08-0.12	7.4-8.4	<2	Low----------	0.10		
	17-60	0-1	>20	0.03-0.05	7.9-8.4	<2	Low----------	0.02		
59*:										
Wilaha----------	0-5	20-25	0.6-2.0	0.10-0.14	7.4-8.4	<2	Low----------	0.24	2	8
	5-14	28-35	0.2-0.6	0.15-0.19	7.4-8.4	<2	Moderate-----	0.28		
	14-17	20-25	0.2-0.6	0.08-0.12	7.4-8.4	<2	Low----------	0.10		
	17-60	0-1	>20	0.03-0.05	7.9-8.4	<2	Low----------	0.02		
Wukoki----------	0-10	18-25	0.6-2.0	0.05-0.08	6.6-7.3	<2	Low----------	0.10	2	8
	10-18	18-25	0.6-2.0	0.05-0.08	7.9-8.4	<2	Low----------	0.10		
	18-65	0-1	>20	0.03-0.05	7.9-8.4	<2	Low----------	0.02		
60--------------- Winona	0-2	15-25	0.6-2.0	0.08-0.15	7.4-8.4	<2	Low----------	0.15	1	8
	2-15	15-25	0.6-2.0	0.05-0.10	7.4-8.4	<2	Low----------	0.10		
	15	---	---	---	---	---	-------------	----		
61--------------- Winona	0-2	15-25	0.6-2.0	0.05-0.10	7.4-8.4	<2	Low----------	0.15	1	8
	2-15	15-25	0.6-2.0	0.05-0.10	7.4-8.4	<2	Low----------	0.10		
	15	---	---	---	---	---	-------------	----		
62*:										
Winona----------	0-2	15-25	0.6-2.0	0.08-0.15	7.4-8.4	<2	Low----------	0.15	1	8
	2-15	15-25	0.6-2.0	0.05-0.10	7.4-8.4	<2	Low----------	0.10		
	15	---	---	---	---	---	-------------	----		
Boysag----------	0-3	10-20	0.6-2.0	0.11-0.13	6.1-8.4	<2	Low----------	0.15	1	8
	3-13	35-45	0.06-0.2	0.14-0.19	7.9-8.4	<2	High---------	0.17		
	13-16	8-20	0.2-0.6	0.05-0.08	7.9-8.4	<2	Low----------	0.05		
	16	---	---	---	---	---	-------------	----		

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group
	In	Pct	In/hr	In/in	pH	Mmhos/cm				
63*:										
Winona----------	0-2	15-25	0.6-2.0	0.05-0.10	7.4-8.4	<2	Low----------	0.15	1	8
	2-15	15-25	0.6-2.0	0.05-0.10	7.4-8.4	<2	Low----------	0.10		
	15	---	---	---	---	---	-------------	----		
Epikom----------	0-3	10-20	2.0-6.0	0.13-0.15	7.4-8.4	<4	Low----------	0.28	1	3
	3-15	15-20	0.6-2.0	0.11-0.13	7.9-9.0	<4	Low----------	0.32		
	15	---	---	---	---	---	-------------	----		
64*, 65*:										
Winona----------	0-2	15-25	0.6-2.0	0.08-0.15	7.4-8.4	<2	Low----------	0.15	1	8
	2-15	15-25	0.6-2.0	0.05-0.10	7.4-8.4	<2	Low----------	0.10		
	15	---	---	---	---	---	-------------	----		
Rock outcrop.										
66*:										
Winona----------	0-2	15-25	0.6-2.0	0.08-0.15	7.4-8.4	<2	Low----------	0.15	1	8
	2-15	15-25	0.6-2.0	0.05-0.10	7.4-8.4	<2	Low----------	0.10		
	15	---	---	---	---	---	-------------	----		
Tusayan---------	0-3	8-13	2.0-6.0	0.07-0.09	7.9-8.4	<2	Low----------	0.17	2	8
	3-29	18-30	0.6-2.0	0.05-0.07	7.9-8.4	<2	Low----------	0.10		
	29	---	---	---	---	---	-------------	----		
67*:										
Wukoki----------	0-10	18-25	0.6-2.0	0.05-0.08	7.4-8.4	<2	Low----------	0.10	2	8
	10-18	18-25	0.6-2.0	0.05-0.08	7.4-8.4	<2	Low----------	0.10		
	18-60	0-1	>20	0.03-0.05	7.9-8.4	<2	Low----------	0.02		
Rock outcrop.										
68*:										
Wukoki----------	0-10	18-25	0.6-2.0	0.05-0.08	7.4-8.4	<2	Low----------	0.10	2	8
	10-18	18-25	0.6-2.0	0.05-0.08	7.4-8.4	<2	Low----------	0.10		
	18-60	0-1	>20	0.03-0.05	7.9-8.4	<2	Low----------	0.02		
Wupatki---------	0-6	18-25	0.6-2.0	0.07-0.09	7.4-8.4	<2	Low----------	0.10	1	8
	6-16	18-25	0.6-2.0	0.07-0.09	7.4-8.4	<2	Low----------	0.10		
	16-20	---	---	---	---	---	-------------	----		
	20-60	0-1	>20	0.03-0.05	7.9-8.4	<2	Low----------	0.02		
69*:										
Wupatki---------	0-6	18-25	0.6-2.0	0.07-0.09	7.4-8.4	<2	Low----------	0.10	1	8
	6-16	18-25	0.6-2.0	0.07-0.09	7.4-8.4	<2	Low----------	0.10		
	16-20	---	---	---	---	---	-------------	----		
	20-60	0-1	>20	0.03-0.05	7.9-8.4	<2	Low----------	0.02		
Wukoki----------	0-10	18-25	0.6-2.0	0.05-0.08	7.4-8.4	<2	Low----------	0.10	2	8
	10-18	18-25	0.6-2.0	0.05-0.08	7.4-8.4	<2	Low----------	0.10		
	18-60	0-1	>20	0.03-0.05	7.9-8.4	<2	Low----------	0.02		
70--------------- Ziegler	0-3	30-35	0.2-0.6	0.13-0.18	7.4-8.4	<2	Moderate-----	0.17	2	8
	3-15	45-55	0.06-0.2	0.10-0.13	7.4-8.4	<2	High---------	0.28		
	15-24	35-55	0.2-0.6	0.06-0.11	7.4-8.4	<2	Low----------	0.32		
	24-60	0-1	>20	0.03-0.05	7.4-8.4	<2	Low----------	0.02		
71*:										
Ziegler---------	0-3	30-35	0.2-0.6	0.13-0.18	7.4-8.4	<2	Moderate-----	0.17	2	8
	3-15	45-55	0.06-0.2	0.10-0.13	7.4-8.4	<2	High---------	0.28		
	15-24	35-55	0.2-0.6	0.06-0.11	7.4-8.4	<2	Low----------	0.32		
	24-60	0-1	>20	0.03-0.05	7.4-8.4	<2	Low----------	0.02		
Cross-----------	0-3	30-35	0.2-0.6	0.13-0.18	7.4-8.4	<2	Moderate-----	0.10	1	8
	3-14	45-55	0.06-0.2	0.14-0.17	7.4-8.4	<2	High---------	0.28		
	14-19	35-40	0.06-0.2	0.16-0.18	7.4-8.4	<2	Moderate-----	0.17		
	19	---	---	---	---	---	-------------	----		

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group
	In	Pct	In/hr	In/in	pH	Mmhos/cm				
72*:										
Ziegler	0-3	30-35	0.2-0.6	0.13-0.18	7.4-8.4	<2	Moderate	0.17	2	8
	3-15	45-55	0.06-0.2	0.10-0.13	7.4-8.4	<2	High	0.28		
	15-24	35-55	0.2-0.6	0.06-0.11	7.4-8.4	<2	Low	0.32		
	24-60	0-1	>20	0.03-0.05	7.4-8.4	<2	Low	0.02		
Wilaha	0-5	20-25	0.6-2.0	0.10-0.14	7.4-8.4	<2	Low	0.17	2	8
	5-14	28-35	0.2-0.6	0.15-0.19	7.4-8.4	<2	Moderate	0.28		
	14-17	20-25	0.2-0.6	0.08-0.12	7.4-8.4	<2	Low	0.10		
	17-60	0-1	>20	0.03-0.05	7.9-8.4	<2	Low	0.02		

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--SOIL AND WATER FEATURES

["Flooding" and terms such as "rare" are explained in the text. The symbol > means more than. Absence of an entry indicates that the feature is not a concern]

Soil name and map symbol	Hydro-logic group	Frequency of flooding	Bedrock: Depth	Bedrock: Hardness	Cemented pan: Depth	Cemented pan: Hard-ness	Potential frost action	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete
			In		In				
1 Ashfork	D	None	20-40	Hard	---	---	Low	High	Low.
2 Aut	B	None	20-40	Hard	---	---	Moderate	High	Low.
3*:									
Aut	B	None	20-40	Hard	---	---	Moderate	High	Low.
Cross	D	None	8-20	Hard	---	---	Low	High	Low.
4*:									
Aut	B	None	20-40	Hard	---	---	Moderate	High	Low.
Lynx	B	Rare	>60	---	---	---	Moderate	Moderate	Low.
5*:									
Badland.									
Torriorthents.									
6*:									
Boquillas	C	None	20-40	Soft	---	---	Low	High	Low.
Seligman	D	None	7-20	Soft	---	---	Low	High	Low.
7 Clovis	B	None	>60	---	---	---	Low	High	Low.
8*:									
Cross	D	None	8-20	Hard	---	---	Low	High	Low.
Apache	D	None	6-20	Hard	---	---	Moderate	High	Low.
9*:									
Daze	D	None	10-20	Hard	---	---	Low	High	Low.
Deama	D	None	6-20	Hard	---	---	Moderate	Moderate	Low.
10, 11 Deama	D	None	6-20	Hard	---	---	Moderate	Moderate	Low.
12*:									
Deama	D	None	6-20	Hard	---	---	Moderate	Moderate	Low.
Rock outcrop.									
13*:									
Deama	D	None	6-20	Hard	---	---	Moderate	Moderate	Low.
Toqui	D	None	8-20	Hard	---	---	Low	High	Low.
14*:									
Deama	D	None	6-20	Hard	---	---	Moderate	Moderate	Low.
Tovar	C	None	20-40	Hard	---	---	Low	Moderate	Low.
15 Disterheff	C	None	>60	---	---	---	Moderate	High	Low.

See footnote at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Frequency of flooding	Bedrock		Cemented pan		Potential frost action	Risk of corrosion	
			Depth	Hardness	Depth	Hardness		Uncoated steel	Concrete
			In		In				
16*:									
Disterheff	C	None	>60	---	---	---	Moderate	High	Low.
Kopie	D	None	10-20	Hard	---	---	Low	High	Low.
17 Epikom	D	None	10-20	Hard	---	---	Low	High	Low.
18*:									
Epikom	D	None	10-20	Hard	---	---	Low	High	Low.
Epikom	D	None	10-20	Hard	---	---	Low	High	Low.
19*:									
Epikom	D	None	10-20	Hard	---	---	Low	High	Low.
Rock outcrop.									
20*:									
Faraway	D	None	5-20	Hard	---	---	Moderate	Moderate	Low.
Rock outcrop.									
21*:									
Keeseha	C	None	>60	---	---	---	Low	High	Low.
Poley	C	None	>60	---	---	---	Low	High	Low.
22*:									
Kopie	D	None	10-20	Hard	---	---	Low	High	Low.
Servilleta	C	None	20-40	Hard	---	---	Low	High	Low.
23*: Lava flows									
24*:									
Lomaki	B	None	>60	---	---	---	Moderate	High	Low.
Nalaki	C	None	>60	---	20-40	Thin	Moderate	High	Low.
25*:									
Mespun	A	None	>60	---	---	---	Low	Low	Low.
Palma	B	None	>60	---	---	---	Low	Moderate	Low.
26 Navajo	D	Rare	>60	---	---	---	Low	High	Low.
27 Palma	B	None	>60	---	---	---	Low	Moderate	Low.
28 Pastura	D	None	>60	---	6-20	Thick	Low	High	Low.
29*:									
Paymaster	B	Rare	>60	---	---	---	Moderate	Moderate	Low.
Lynx	B	Rare	>60	---	---	---	Moderate	Moderate	Low.
30, 31 Poley	C	None	>60	---	---	---	Low	High	Low.

See footnote at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Frequency of flooding	Bedrock		Cemented pan		Potential frost action	Risk of corrosion	
			Depth	Hardness	Depth	Hard-ness		Uncoated steel	Concrete
			In		In				
32*:									
Poley	C	None	>60	---	---	---	Low	High	Low.
Lynx	B	Rare	>60	---	---	---	Moderate	Moderate	Low.
33*:									
Poley	C	None	>60	---	---	---	Low	High	Low.
Tusayan	C	None	20-40	Hard	---	---	Low	High	Low.
34 Purgatory	D	None	20-40	Soft	---	---	Low	High	Low.
35 Quivera	C	None	>60	---	---	---	Low	Moderate	Low.
36*: Riverwash									
37 Rune	C	Rare	>60	---	---	---	Low	High	Low.
38*:									
Rune	C	Rare	>60	---	---	---	Low	High	Low.
Disterheff	C	None	>60	---	---	---	Moderate	High	Low.
39 Servilleta	C	None	20-40	Hard	---	---	Low	High	Low.
40*:									
Servilleta	C	None	20-40	Hard	---	---	Low	High	Low.
Tusayan	C	None	20-40	Hard	---	---	Low	High	Low.
41, 42 Showlow	C	None	>60	---	---	---	Moderate	Moderate	Low.
43 Springerville	D	None	40-60	Hard	---	---	Low	High	Low.
44 Springerville	D	None	40-60	Hard	---	---	Low	High	Low.
45*:									
Tajo	C	None	40-60	Hard	20-40	Thick	Moderate	Moderate	Low.
Springerville	D	None	40-60	Hard	---	---	Low	High	Low.
46 Tenorio	C	None	>60	---	---	---	Low	Moderate	Low.
47*:									
Thunderbird	D	None	20-40	Hard	---	---	Low	High	Low.
Cabezon	D	None	10-20	Hard	---	---	Low	High	Low.
48*:									
Thunderbird	D	None	20-40	Hard	---	---	Low	High	Low.
Rock outcrop.									

See footnote at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Frequency of flooding	Bedrock		Cemented pan		Potential frost action	Risk of corrosion	
			Depth	Hardness	Depth	Hardness		Uncoated steel	Concrete
			In		In				
49*:									
Thunderbird	D	None	20-40	Hard	---	---	Low	High	Low.
Springerville	D	None	40-60	Hard	---	---	Low	High	Low.
50*. Torrifluvents									
51 Tours	B	Rare	>60	---	---	---	Low	High	Low.
52*:									
Tours	B	Rare	>60	---	---	---	Low	High	Low.
Ives	B	Rare	>60	---	---	---	Low	Moderate	Low.
53*, 54*:									
Tovar	C	None	20-40	Hard	---	---	Low	Moderate	Low.
Tovar	C	None	20-40	Hard	---	---	Low	Moderate	Low.
55*:									
Tusayan	C	None	20-40	Hard	---	---	Low	High	Low.
Lynx	B	Rare	>60	---	---	---	Moderate	Moderate	Low.
56 Tuweep	B	None	>60	---	---	---	Low	High	Low.
57 Valle	B	None	>60	---	---	---	Moderate	Moderate	Low.
58 Wilaha	B	None	>60	---	---	---	Moderate	High	Low.
59*:									
Wilaha	B	None	>60	---	---	---	Moderate	High	Low.
Wukoki	B	None	>60	---	---	---	Moderate	High	Low.
60, 61 Winona	D	None	6-20	Hard	---	---	Low	Moderate	Low.
62*:									
Winona	D	None	6-20	Hard	---	---	Low	Moderate	Low.
Boysag	D	None	10-20	Hard	---	---	Low	High	Low.
63*:									
Winona	D	None	6-20	Hard	---	---	Low	Moderate	Low.
Epikom	D	None	10-20	Hard	---	---	Low	High	Low.
64*, 65*:									
Winona	D	None	6-20	Hard	---	---	Low	Moderate	Low.
Rock outcrop.									
66*:									
Winona	D	None	6-20	Hard	---	---	Low	Moderate	Low.
Tusayan	C	None	20-40	Hard	---	---	Low	High	Low.

See footnote at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Frequency of flooding	Bedrock		Cemented pan		Potential frost action	Risk of corrosion	
			Depth	Hardness	Depth	Hardness		Uncoated steel	Concrete
			In		In				
67*:									
Wukoki	B	None	>60	---	---	---	Moderate	High	Low.
Rock outcrop.									
68*:									
Wukoki	B	None	>60	---	---	---	Moderate	High	Low.
Wupatki	D	None	>60	---	8-20	Thin	Moderate	High	Low.
69*:									
Wupatki	D	None	>60	---	8-20	Thin	Moderate	High	Low.
Wukoki	B	None	>60	---	---	---	Moderate	High	Low.
70 Ziegler	C	None	>60	---	---	---	Low	Moderate	Low.
71*:									
Ziegler	C	None	>60	---	---	---	Low	Moderate	Low.
Cross	D	None	8-20	Hard	---	---	Low	High	Low.
72*:									
Ziegler	C	None	>60	---	---	---	Low	Moderate	Low.
Wilaha	B	None	>60	---	---	---	Moderate	High	Low.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--CLASSIFICATION OF THE SOILS

[An asterisk in the first column indicates that the soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series]

Soil name	Family or higher taxonomic class
Apache	Loamy, mixed, mesic Lithic Haplustolls
Ashfork	Fine, montmorillonitic, mesic Aridic Argiustolls
Aut	Fine-loamy, carbonatic, mesic Aridic Calciustolls
Boquillas	Fine, montmorillonitic, mesic Aridic Argiustolls
Boysag	Clayey, mixed, mesic Lithic Ustollic Haplargids
Cabezon	Clayey, montmorillonitic, mesic Lithic Argiustolls
Clovis	Fine-loamy, mixed, mesic Ustollic Haplargids
Cross	Clayey, montmorillonitic, mesic Lithic Argiustolls
Daze	Clayey, mixed, mesic Lithic Argiustolls
Deama	Loamy-skeletal, carbonatic, mesic Lithic Calciustolls
Disterheff	Fine, montmorillonitic, mesic Aridic Paleustalfs
Epikom	Loamy, mixed, mesic Lithic Camborthids
Faraway	Loamy-skeletal, mixed, mesic Lithic Haplustolls
Ives	Coarse-loamy, mixed (calcareous), mesic Typic Torrifluvents
Keeseha	Fine, mixed, mesic Ustollic Haplargids
Kopie	Loamy, mixed, mesic Lithic Ustochrepts
Lomaki	Cindery, mesic Aridic Haplustolls
*Lynx	Fine-loamy, mixed, mesic Cumulic Haplustolls
Mespun	Mixed, mesic Ustic Torripsamments
Nalaki	Cindery, mesic Aridic Durustolls
Navajo	Fine, mixed (calcareous), mesic Vertic Torrifluvents
Palma	Coarse-loamy, mixed, mesic Ustollic Haplargids
Pastura	Loamy, mixed, mesic, shallow Ustollic Paleorthids
Paymaster	Coarse-loamy, mixed, mesic Cumulic Haplustolls
Poley	Fine, mixed, mesic Ustollic Haplargids
Purgatory	Fine-loamy, gypsic, mesic Typic Gypsiorthids
Quivera	Fine, mixed, mesic Aridic Argiustolls
Rune	Fine, mixed, mesic Cumulic Haplustolls
Seligman	Clayey, montmorillonitic, mesic, shallow Aridic Argiustolls
Servilleta	Fine, mixed, mesic Ustollic Haplargids
Showlow	Fine, montmorillonitic, mesic Aridic Argiustolls
Springerville	Fine, montmorillonitic, mesic Udic Chromusterts
Tajo	Fine-loamy, mixed, mesic Petrocalcic Paleustolls
Tenorio	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Ustollic Haplargids
Thunderbird	Fine, montmorillonitic, mesic Aridic Argiustolls
Toqui	Clayey, mixed, mesic Lithic Haplustalfs
Tours	Fine-silty, mixed (calcareous), mesic Typic Torrifluvents
Tovar	Fine, mixed, mesic Aridic Haplustalfs
Tusayan	Loamy-skeletal, carbonatic, mesic Ustollic Calciorthids
Tuweep	Fine-loamy, mixed, mesic Ustollic Haplargids
Valle	Fine-loamy, mixed, mesic Aridic Haplustolls
Wilaha	Fine-loamy over fragmental, mixed, mesic Aridic Argiustolls
Winona	Loamy-skeletal, mixed, mesic Lithic Ustollic Calciorthids
Wukoki	Cindery, mesic Aridic Haplustolls
Wupatki	Cindery, mesic, shallow Aridic Durustolls
Ziegler	Clayey over fragmental, montmorillonitic, mesic Aridic Argiustolls

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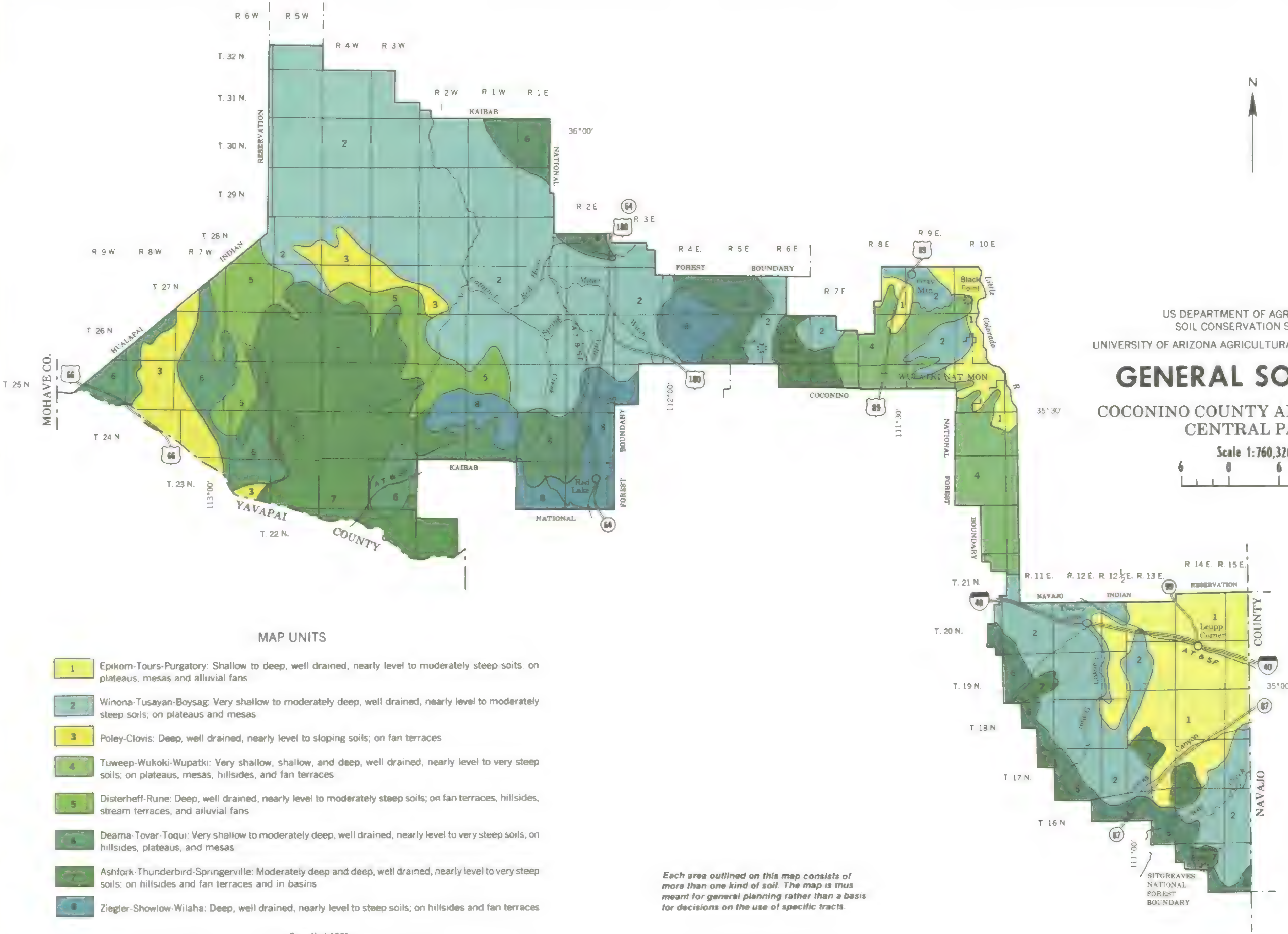
US DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
UNIVERSITY OF ARIZONA AGRICULTURAL EXPERIMENT STATION

GENERAL SOIL MAP

COCONINO COUNTY AREA, ARIZONA, CENTRAL PART

Scale 1:760,320



MAP UNITS

1 Epikom-Tours-Purgatory: Shallow to deep, well drained, nearly level to moderately steep soils; on plateaus, mesas and alluvial fans

2 Winona-Tusayan-Boysag: Very shallow to moderately deep, well drained, nearly level to moderately steep soils; on plateaus and mesas

3 Poley-Clovis: Deep, well drained, nearly level to sloping soils; on fan terraces

4 Tuweep-Wukoki-Wupatki: Very shallow, shallow, and deep, well drained, nearly level to very steep soils; on plateaus, mesas, hillsides, and fan terraces

5 Disterheff-Rune: Deep, well drained, nearly level to moderately steep soils; on fan terraces, hillsides, stream terraces, and alluvial fans

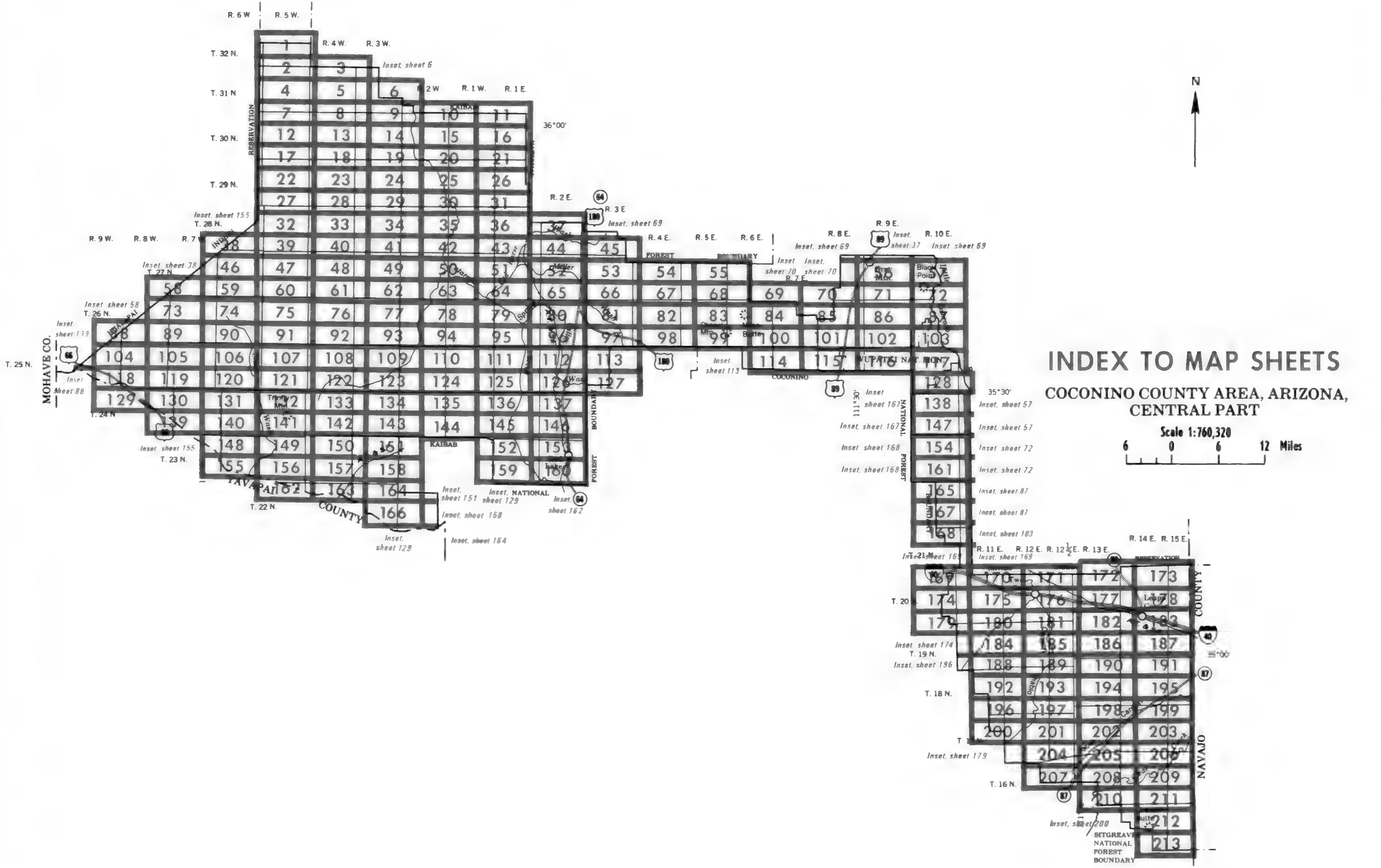
6 Deama-Tovar-Toqui: Very shallow to moderately deep, well drained, nearly level to very steep soils; on hillsides, plateaus, and mesas

7 Ashfork-Thunderbird-Springerville: Moderately deep and deep, well drained, nearly level to very steep soils; on hillsides and fan terraces and in basins

8 Ziegler-Showlow-Wilaha: Deep, well drained, nearly level to steep soils; on hillsides and fan terraces

Compiled 1981

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.


INDEX TO MAP SHEETS
COCONINO COUNTY AREA, ARIZONA, CENTRAL PART
Scale 1:760,320
6 0 6 12 Miles
N
MOHAVE CO.
YAVAPAI COUNTY
NAVAJO COUNTY
SITGREAVES NATIONAL FOREST BOUNDARY

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

- National, state or province
- County or parish
- Minor civil division
- Reservation (national forest or park, state forest or park, and large airport)
- Land grant
- Limit of soil survey (label)
- Field sheet matchline & neatline

AD HOC BOUNDARY (label)

- Small airport, airfield, park, oilfield, cemetery, or flood pool (Davis Airstrip; FLOOD POOL LINE)

STATE COORDINATE TICK

LAND DIVISION CORNERS
(sections and land grants)

ROADS

- Divided (median shown if scale permits)
- Other roads
- Trail

ROAD EMBLEMS & DESIGNATIONS

- Interstate (79)
- Federal (410)
- State (52)
- County, farm or ranch (378)

RAILROAD

POWER TRANSMISSION LINE
(normally not shown)

PIPE LINE
(normally not shown)

FENCE
(normally not shown)

LEVEES

- Without road
- With road
- With railroad

DAMS

- Large (to scale)
- Medium or small (water; w)

PITS

- Gravel pit (G.P.)
- Mine or quarry

MISCELLANEOUS CULTURAL FEATURES

- Farmstead, house (omit in urban areas)
- Church
- School
- Indian mound (label) (Indian Mound)
- Located object (label) (Tower)
- Tank (label) (GAS)
- Wells, oil or gas
- Windmill
- Kitchen midden

WATER FEATURES

DRAINAGE

- Perennial, double line
- Perennial, single line
- Intermittent
- Drainage end
- Canals or ditches
  - Double-line (label) (CANAL)
  - Drainage and/or irrigation

LAKES, PONDS AND RESERVOIRS

- Perennial (water; w)
- Intermittent (int; i)

MISCELLANEOUS WATER FEATURES

- Marsh or swamp
- Spring
- Well, artesian
- Well, irrigation
- Wet spot

SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS
(SvE; 107)

ESCARPMENTS

- Bedrock (points down slope)
- Other than bedrock (points down slope)

SHORT STEEP SLOPE

GULLY

DEPRESSION OR SINK

SOIL SAMPLE SITE
(normally not shown) (S)

MISCELLANEOUS

- Blowout
- Clay spot
- Gravelly spot
- Gumbo, slick or scabby spot (sodic)
- Dumps and other similar non soil areas
- Prominent hill or peak
- Rock outcrop (includes sandstone and shale)
- Saline spot
- Sandy spot
- Severely eroded spot
- Slide or slip (tips point upslope)
- Stony spot, very stony spot

SOIL LEGEND

SYMBOL	NAME
1	Ashfork gravelly clay loam, 1 to 15 percent slopes
2	Aut gravelly loam, 0 to 8 percent slopes
3	Aut-Cross association, moderately sloping
4	Aut-Lynx association, gently sloping
5	Badland-Torriorthents complex, moderately steep
6	Boquillas-Seligman complex, 1 to 15 percent slopes
7	Clovis loamy sand, 1 to 8 percent slopes
8	Cross-Apache complex, 2 to 15 percent slopes
9	Daze-Deama association, moderately steep
10	Deama gravelly loam, 2 to 15 percent slopes
11	Deama stony loam, 1 to 15 percent slopes
12	Deama-Rock outcrop complex, 8 to 30 percent slopes
13	Deama-Toqui complex, 0 to 8 percent slopes
14	Deama-Tovar association, steep
15	Disterheff very gravelly sandy clay loam, 1 to 15 percent slopes
16	Disterheff-Kopie association, moderately sloping
17	Epikom very cindery loamy sand, 0 to 5 percent slopes
18	Epikom complex, 0 to 15 percent slopes
19	Epikom-Rock outcrop complex, 8 to 60 percent slopes
20	Faraway-Rock outcrop complex, 20 to 80 percent slopes
21	Keeseha-Poley gravelly sandy loams, 0 to 8 percent slopes
22	Kopie-Servilleta association, moderately sloping
23	Lava flows
24	Lomaki-Nalaki very cindery loams, 0 to 8 percent slopes
25	Mespun-Palma complex, 1 to 8 percent slopes
26	Navajo clay, 0 to 5 percent slopes
27	Palma sandy loam, 0 to 5 percent slopes
28	Pastura gravelly loam, 0 to 8 percent slopes
29	Paymaster-Lynx association, gently sloping
30	Poley sandy loam, 0 to 5 percent slopes
31	Poley gravelly loam, 0 to 8 percent slopes
32	Poley-Lynx association, gently sloping
33	Poley-Tusayan association, gently sloping
34	Purgatory gravelly fine sandy loam, 0 to 8 percent slopes
35	Quivera very gravelly loam, 0 to 8 percent slopes
36	Riverwash
37	Rune silty clay loam, 0 to 8 percent slopes
38	Rune-Disterheff association, gently sloping
39	Servilleta fine sandy loam, 1 to 8 percent slopes
40	Servilleta-Tusayan complex, 1 to 8 percent slopes
41	Showlow gravelly fine sandy loam, 0 to 8 percent slopes
42	Showlow gravelly fine sandy loam, 8 to 30 percent slopes
43	Springerville cobbly clay, 0 to 8 percent slopes
44	Springerville very stony clay, 0 to 8 percent slopes
45	Tajo-Springerville complex, 0 to 15 percent slopes
46	Tenorio very gravelly sandy loam, 0 to 8 percent slopes
47	Thunderbird-Cabezon complex, 2 to 30 percent slopes
48	Thunderbird-Rock outcrop complex, 30 to 60 percent slopes
49	Thunderbird-Springerville association, strongly sloping
50	Torrifluvents, saline
51	Tours silty clay loam, 0 to 8 percent slopes
52	Tours-Ives association, gently sloping
53	Tovar complex, 2 to 25 percent slopes
54	Tovar complex, 25 to 60 percent slopes
55	Tusayan-Lynx association, gently sloping
56	Tuweep very gravelly loam, 0 to 15 percent slopes
57	Valle gravelly silt loam, 0 to 8 percent slopes
58	Wilaha cindery loam, 2 to 30 percent slopes
59	Wilaha-Wukoki association, steep
60	Winona gravelly loam, 0 to 8 percent slopes
61	Winona stony loam, 0 to 8 percent slopes
62	Winona-Boysag gravelly loams, 0 to 8 percent slopes
63	Winona-Epikom association, gently sloping
64	Winona-Rock outcrop complex, 15 to 30 percent slopes
65	Winona-Rock outcrop complex, 30 to 70 percent slopes
66	Winona-Tusayan association, gently sloping
67	Wukoki-Rock outcrop complex, 5 to 25 percent slopes
68	Wukoki-Wupatki very cinder loams, 15 to 60 percent slopes
69	Wupatki-Wukoki very cindery loams, 0 to 15 percent slopes
70	Ziegler gravelly loam, 0 to 8 percent slopes
71	Ziegler-Cross association, moderately sloping
72	Ziegler-Wilaha association, strongly sloping

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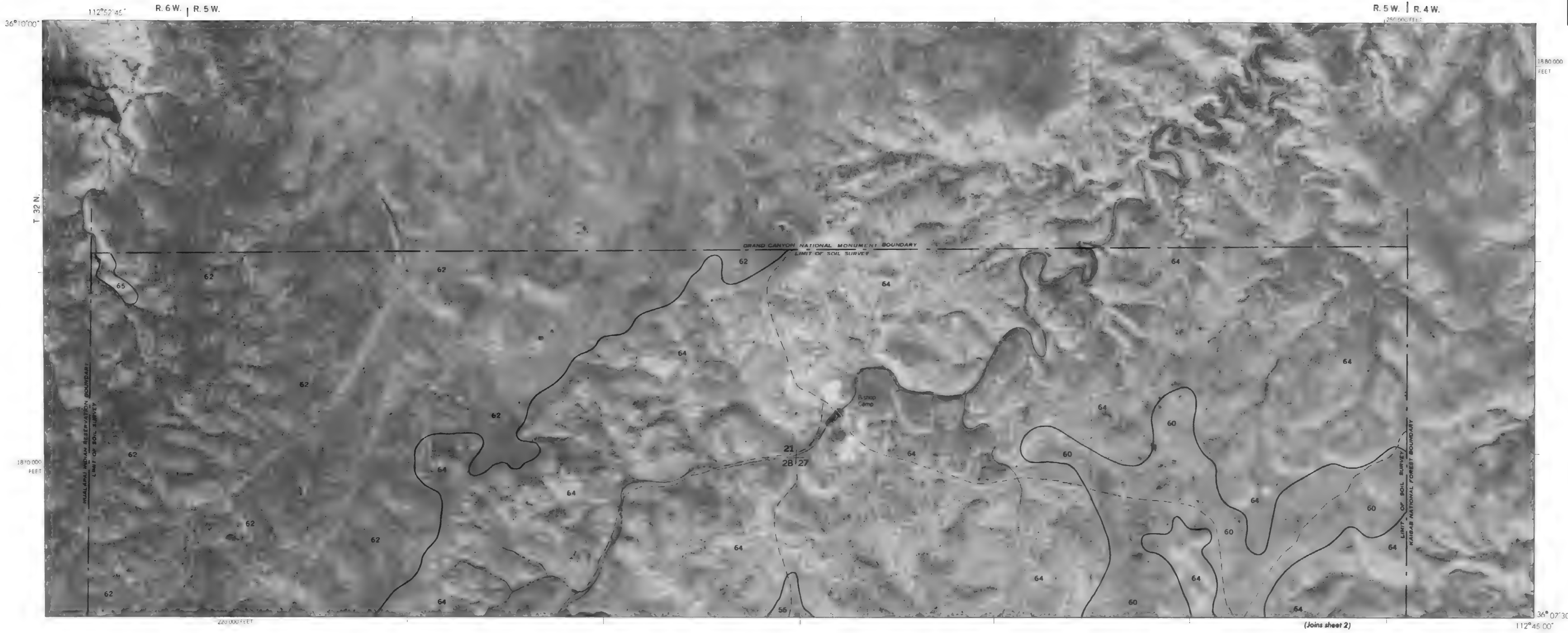

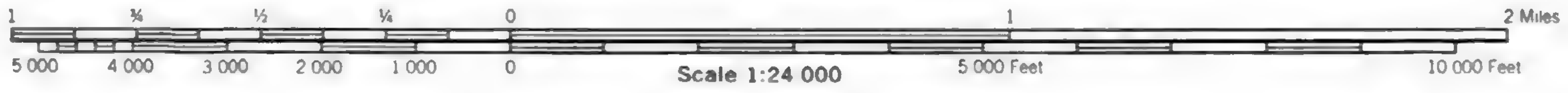

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 1

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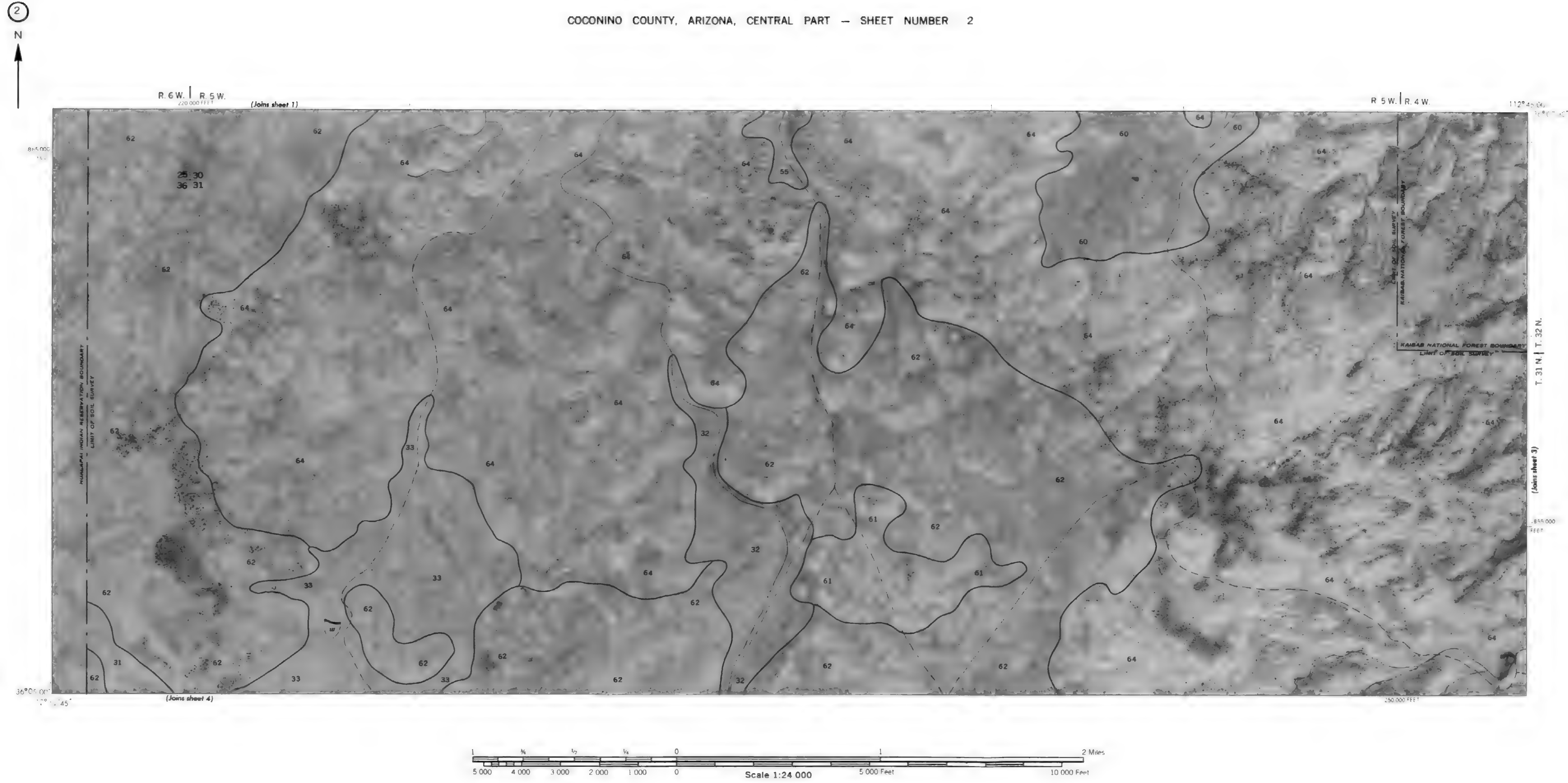
5 000 foot grid ticks based on state coordinate system Land division corners if shown are approximately positioned



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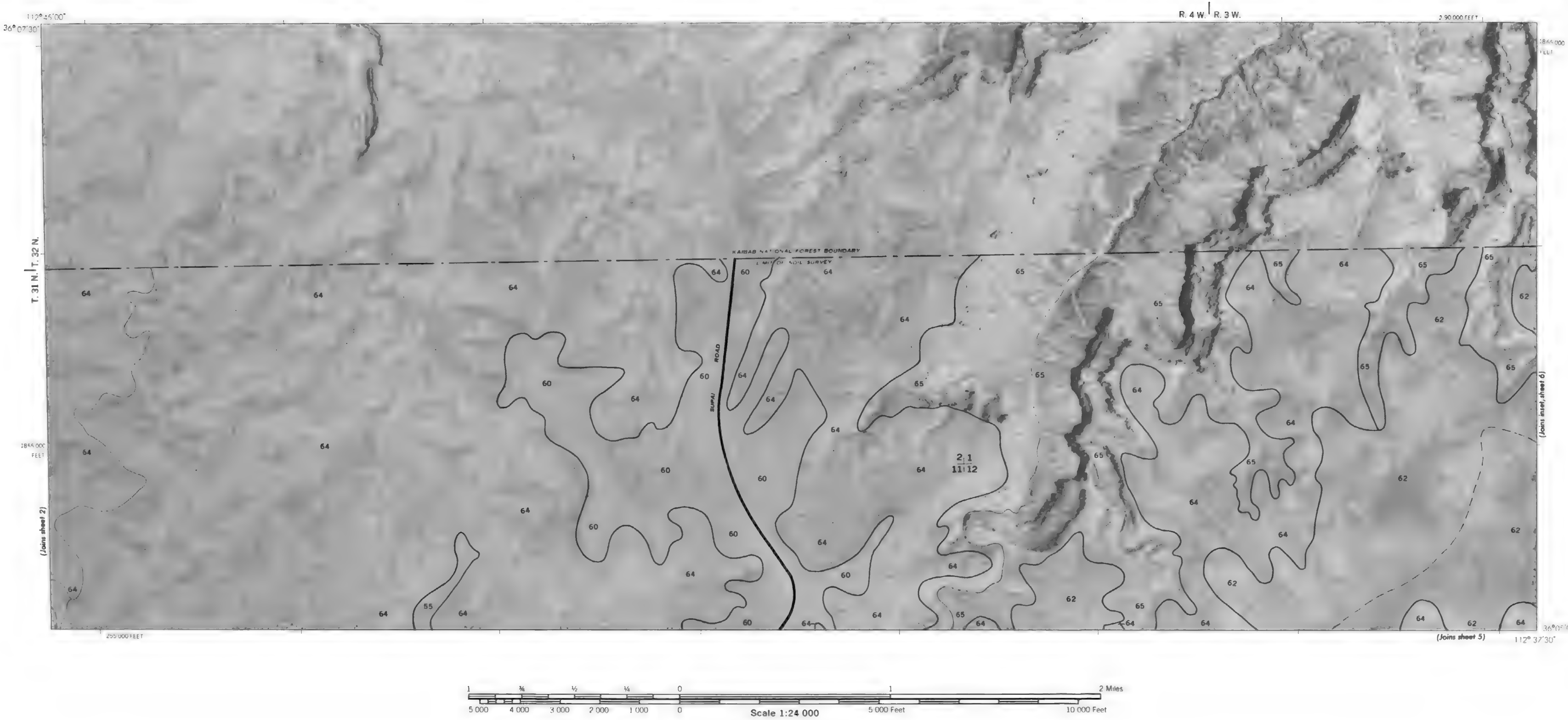

COCONINO COUNTY, ARIZONA, CENTRAL PART — SHEET NUMBER 4

1 ¾ ½ ¼ 0 1 2 Miles
5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet
Scale 1:24 000

5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

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COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 4

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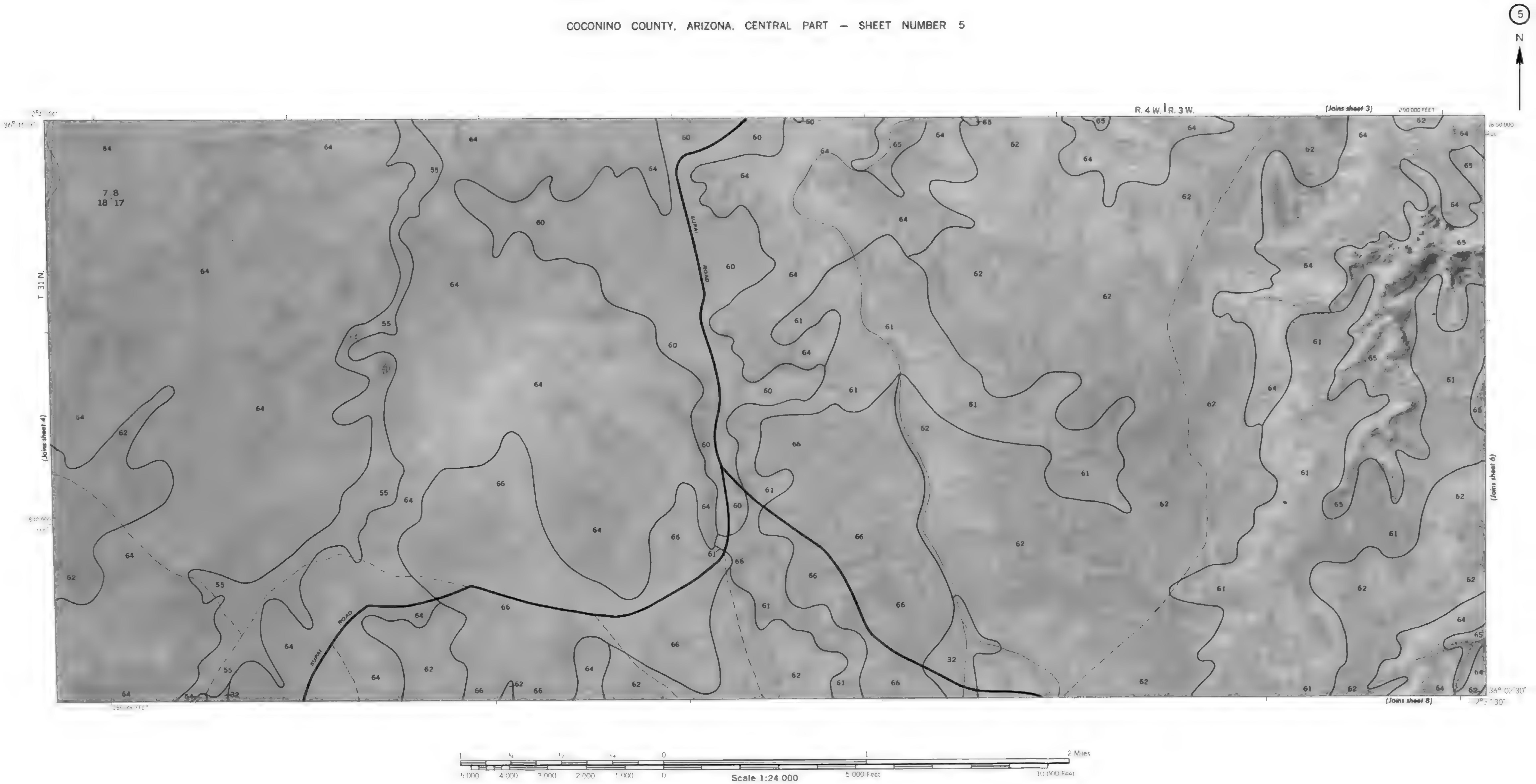

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 5

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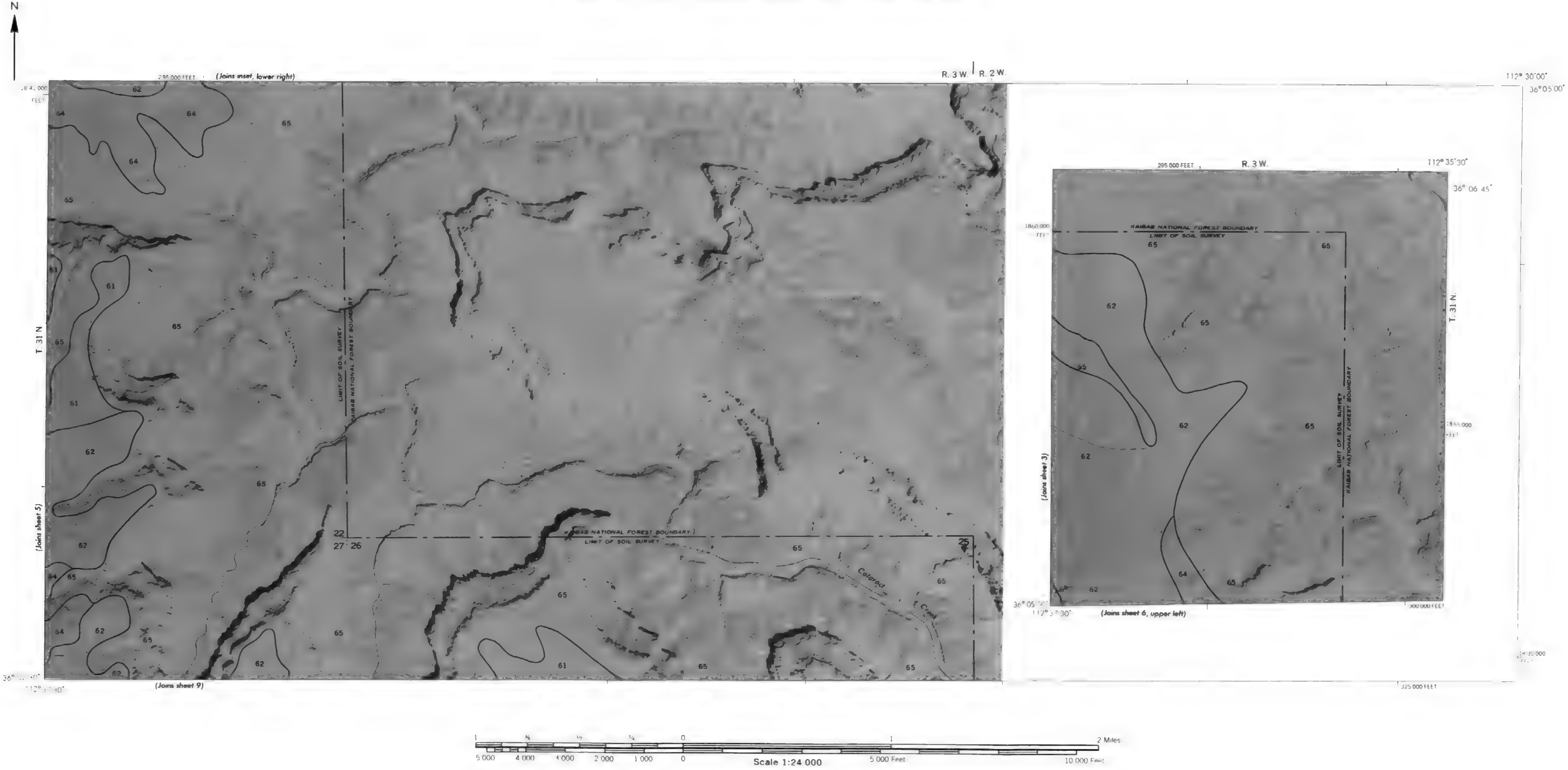

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COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 6

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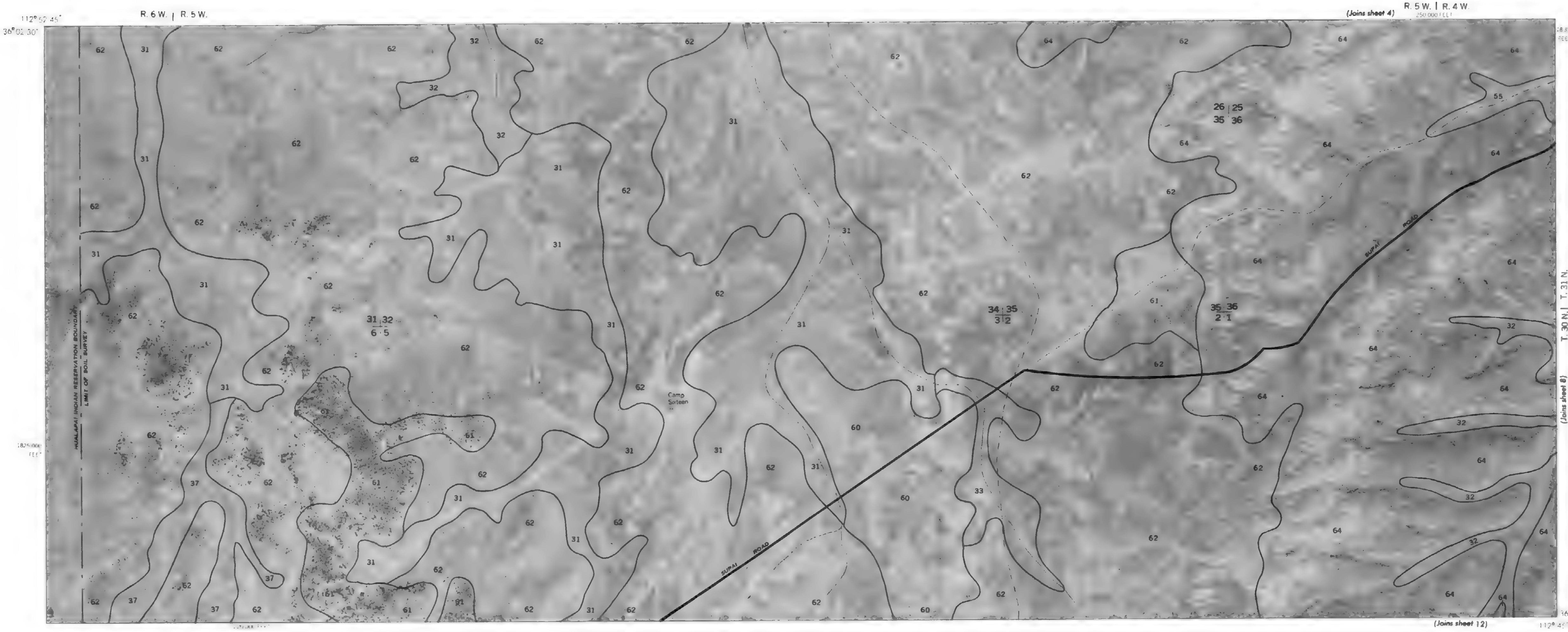

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Scale 1:24 000

This map was compiled on 1972 and 1978 U.S. Department of The Interior Geological Survey orthophotography by the U.S. Department of Agriculture Soil Conservation Service and cooperating agencies.
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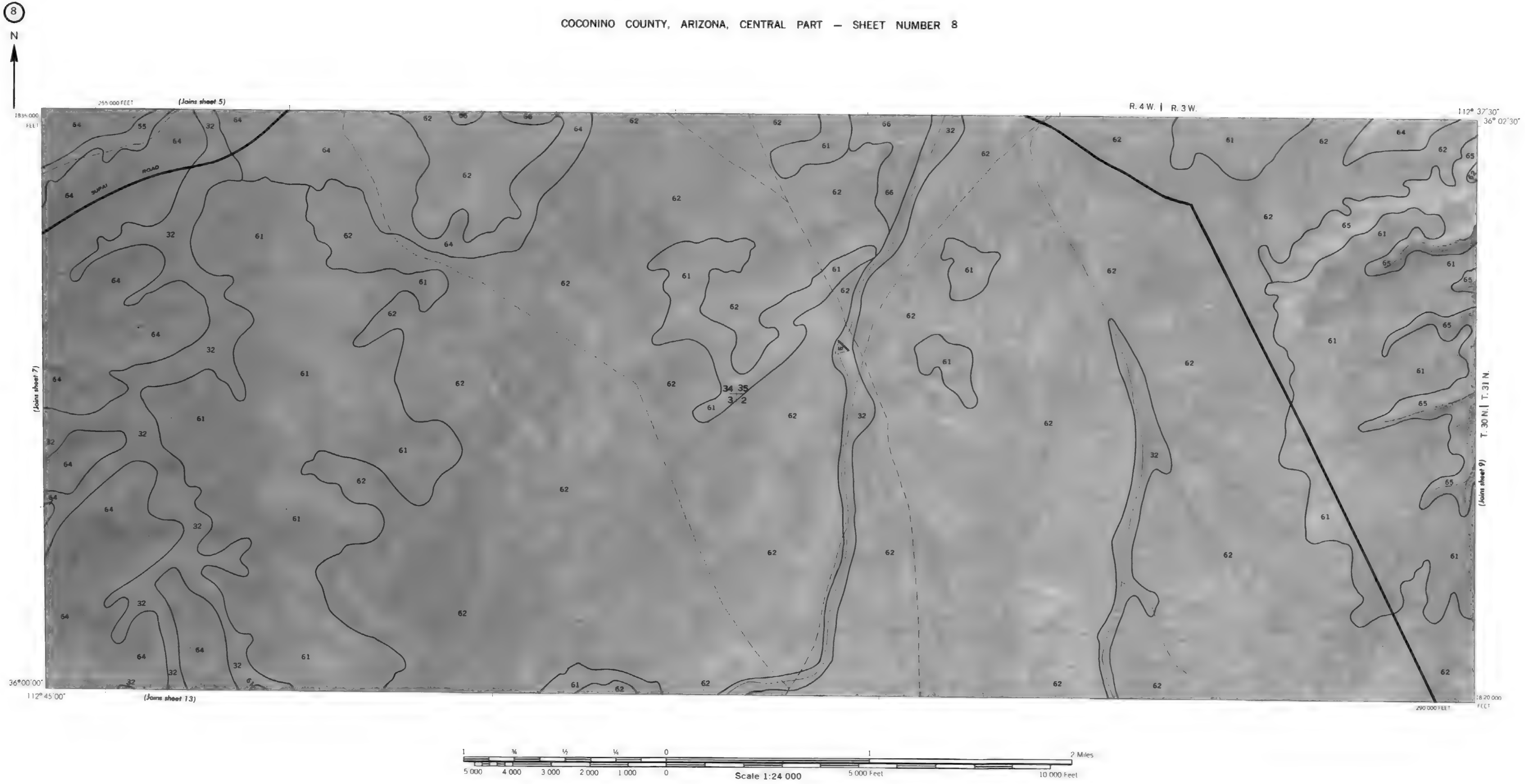

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This map was compiled on 1972 and 1973 U.S. Department of the Interior, Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 8

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 9

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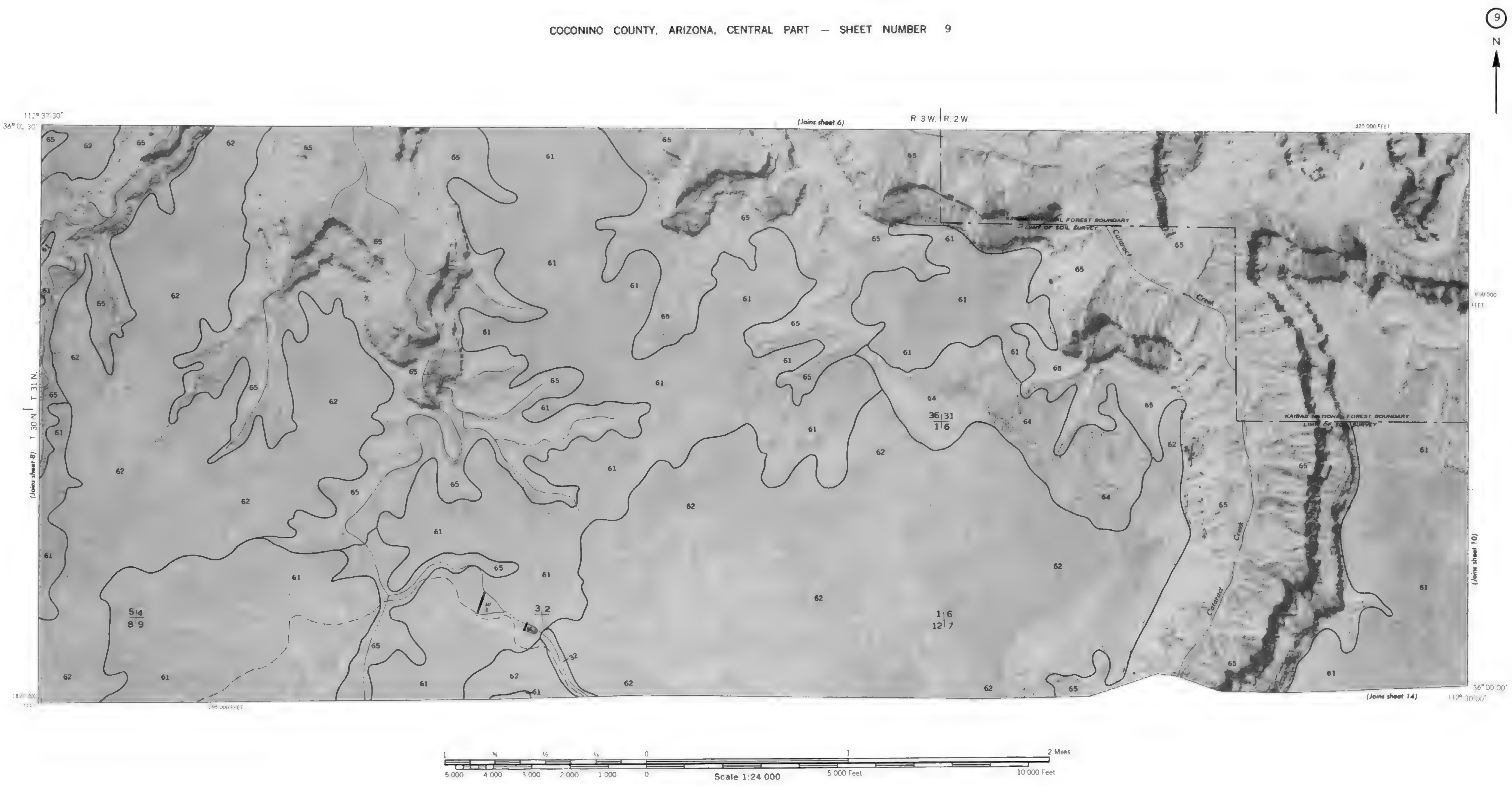

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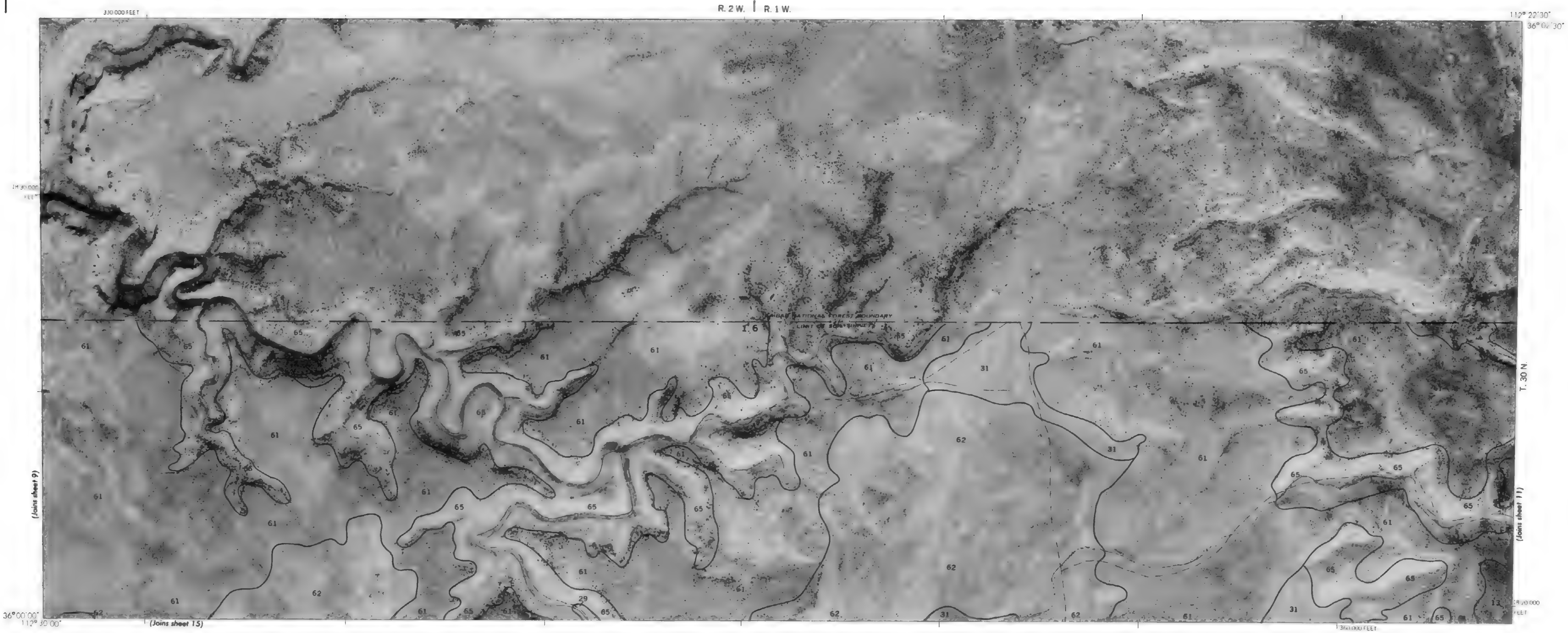

1 ¾ ½ ¼ 0 1 2 Miles

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Scale 1:24 000

5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned

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COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 11

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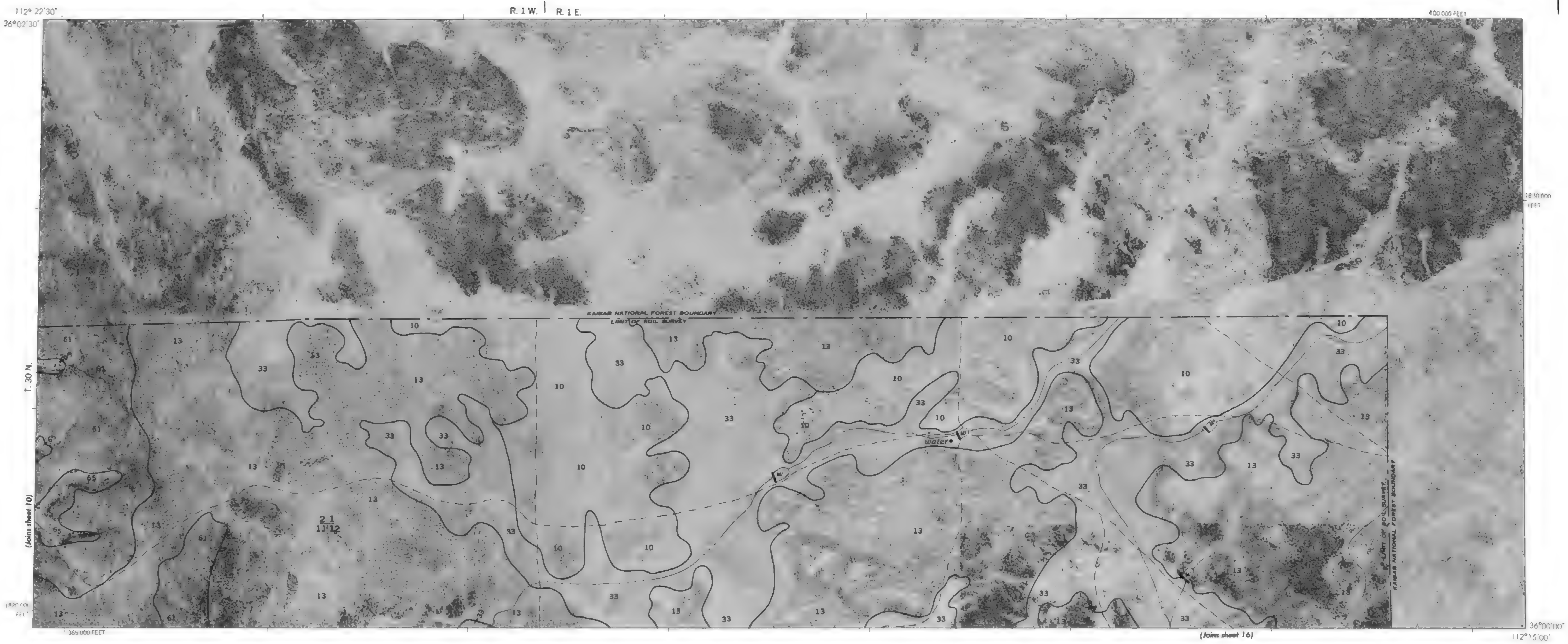

1 ¾ ½ ¼ 0 1 2 Miles

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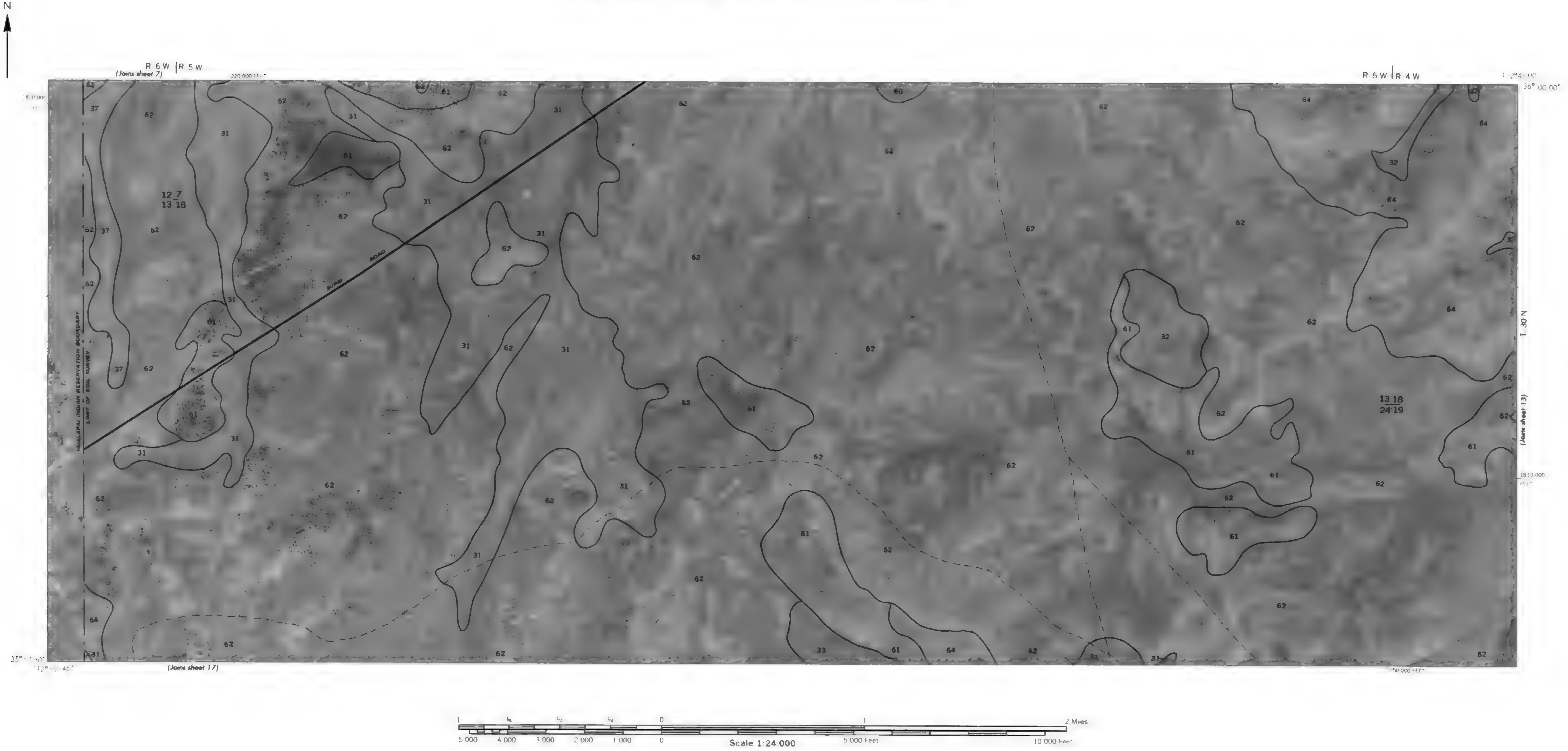
Scale 1:24 000

12

COCONINO COUNTY, ARIZONA, CENTRAL PART — SHEET NUMBER 12



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COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 12

13

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COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 13

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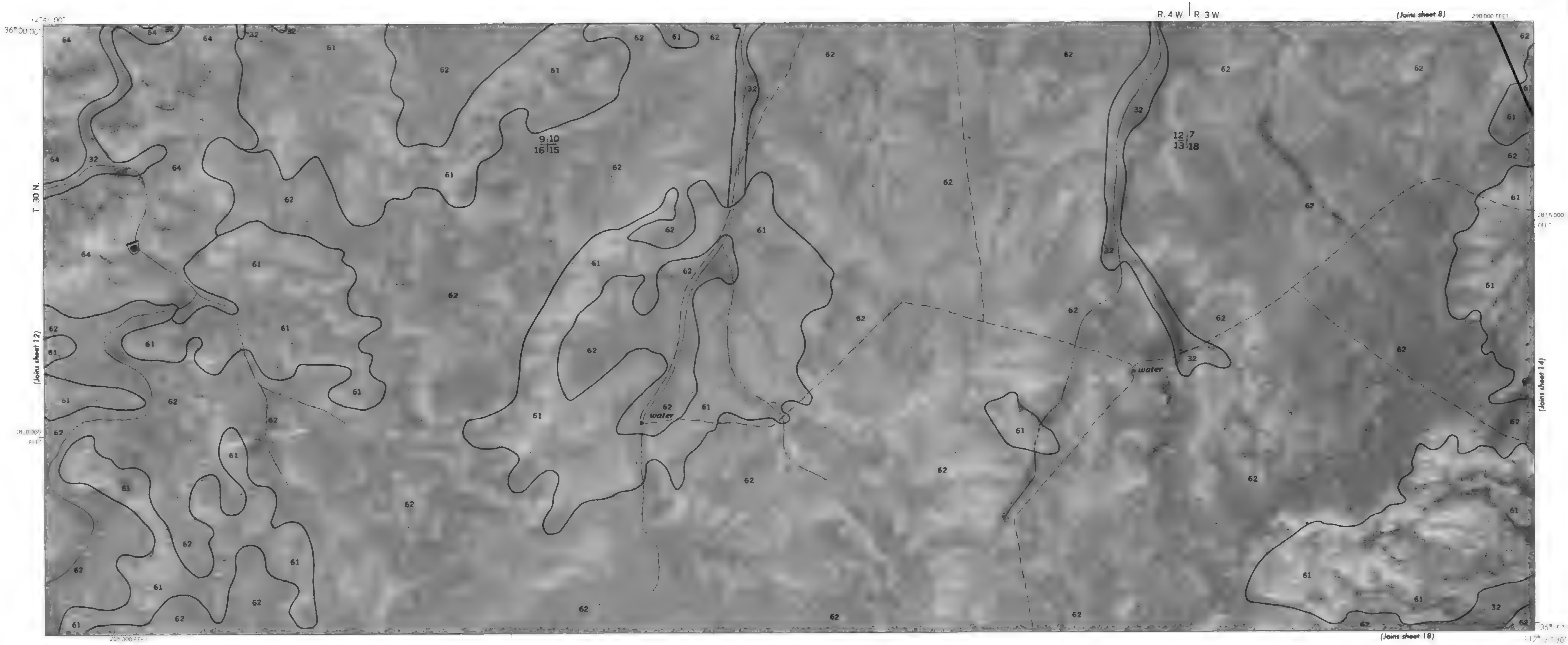

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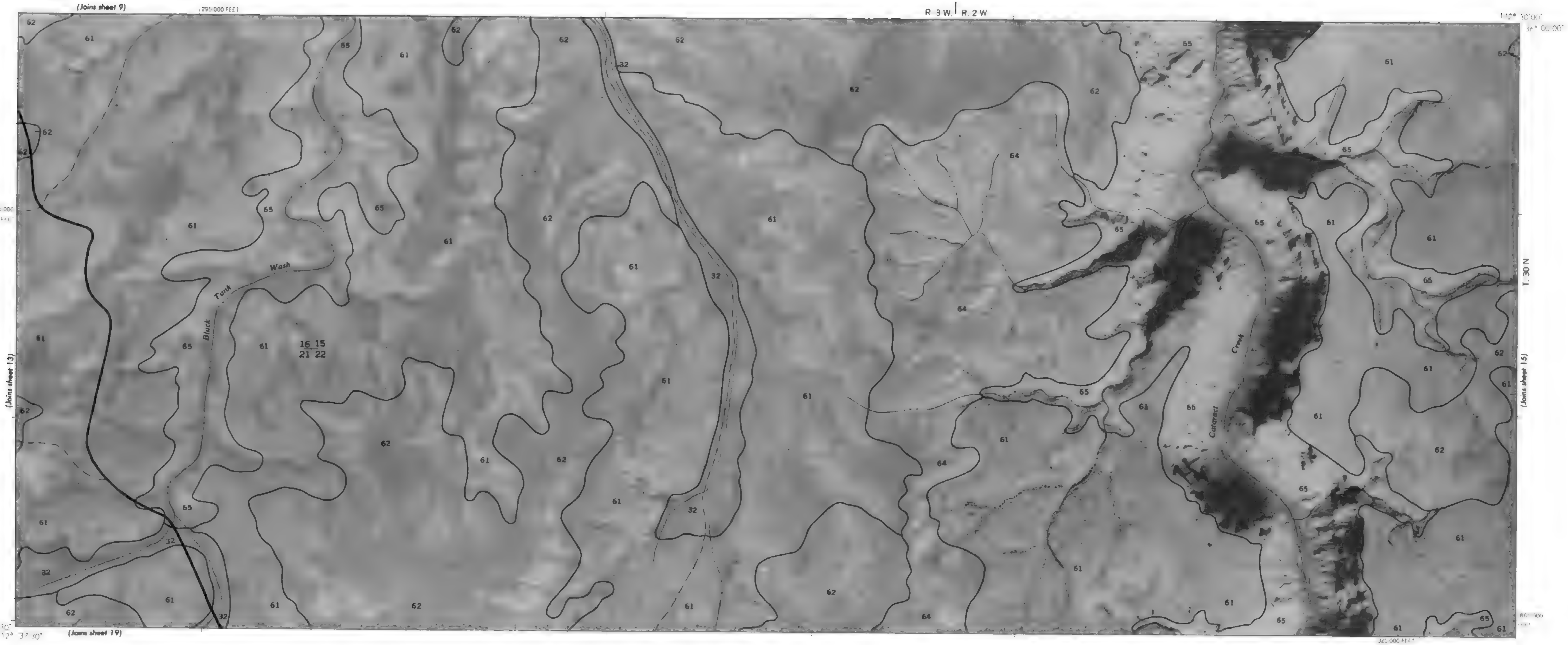

Scale 1:24 000

1 ½ ¼ 0 1 2 Miles

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5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

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COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 14

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 15

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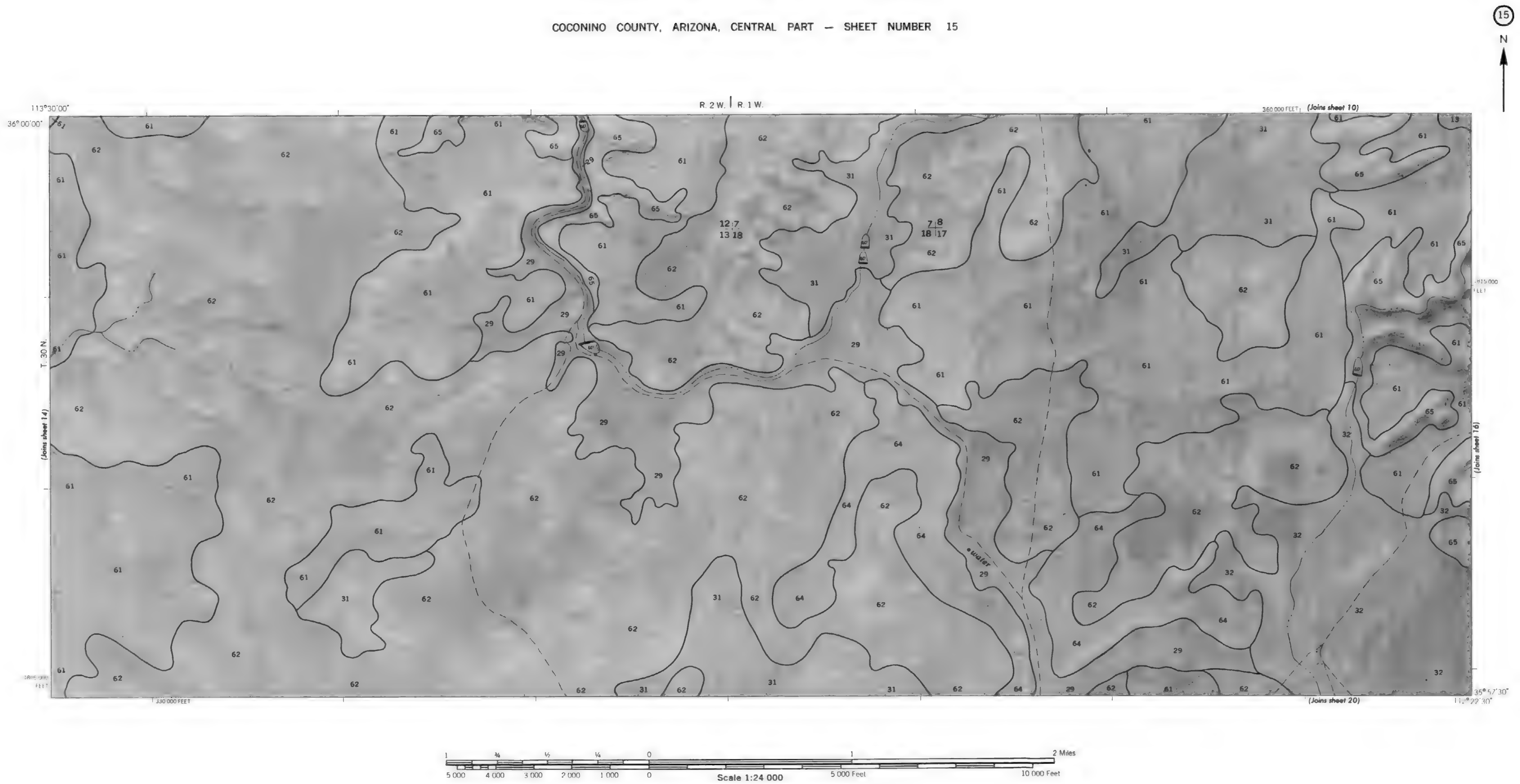
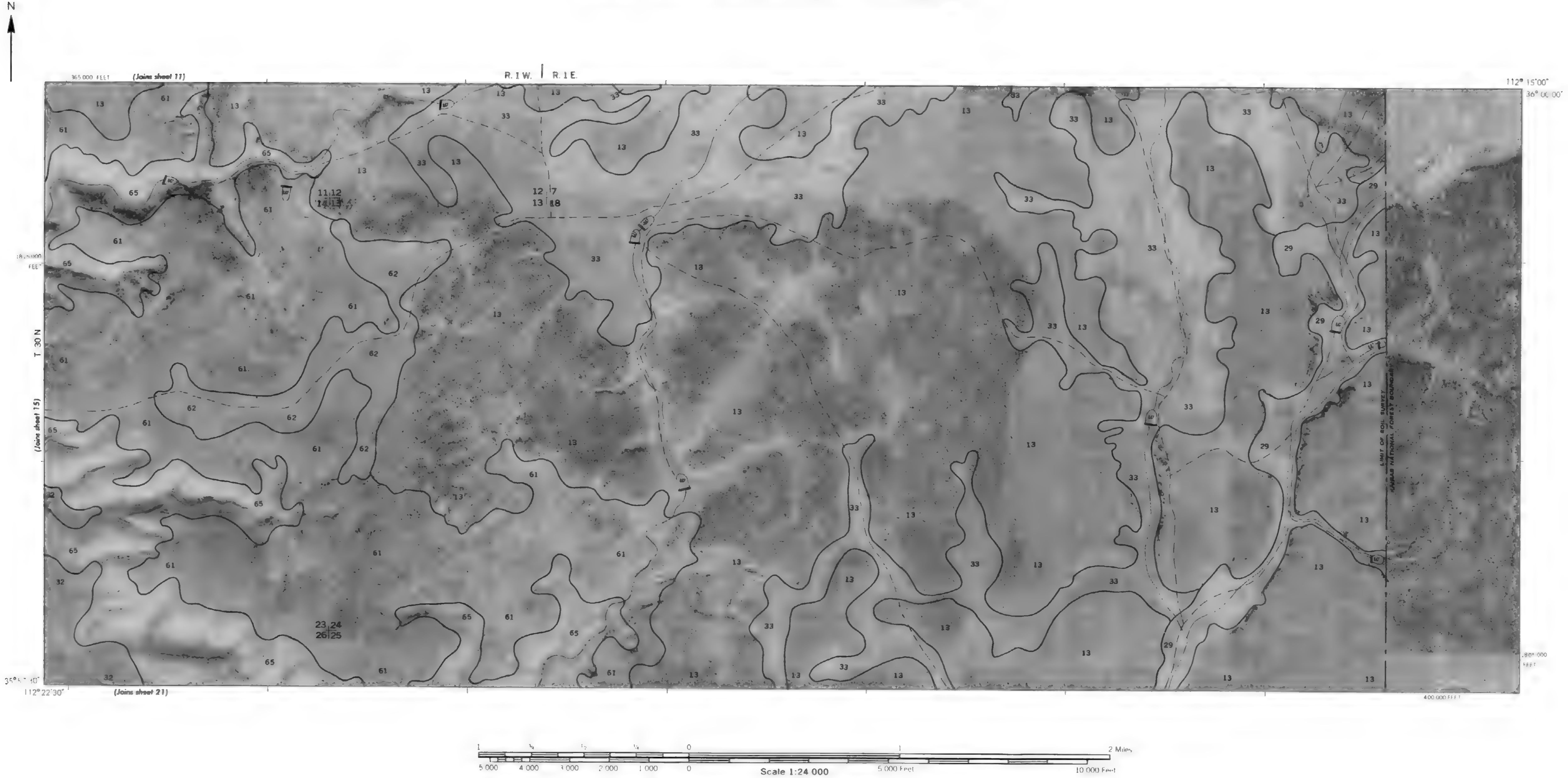


COCONINO COUNTY, ARIZONA, CENTRAL PART — SHEET NUMBER 16



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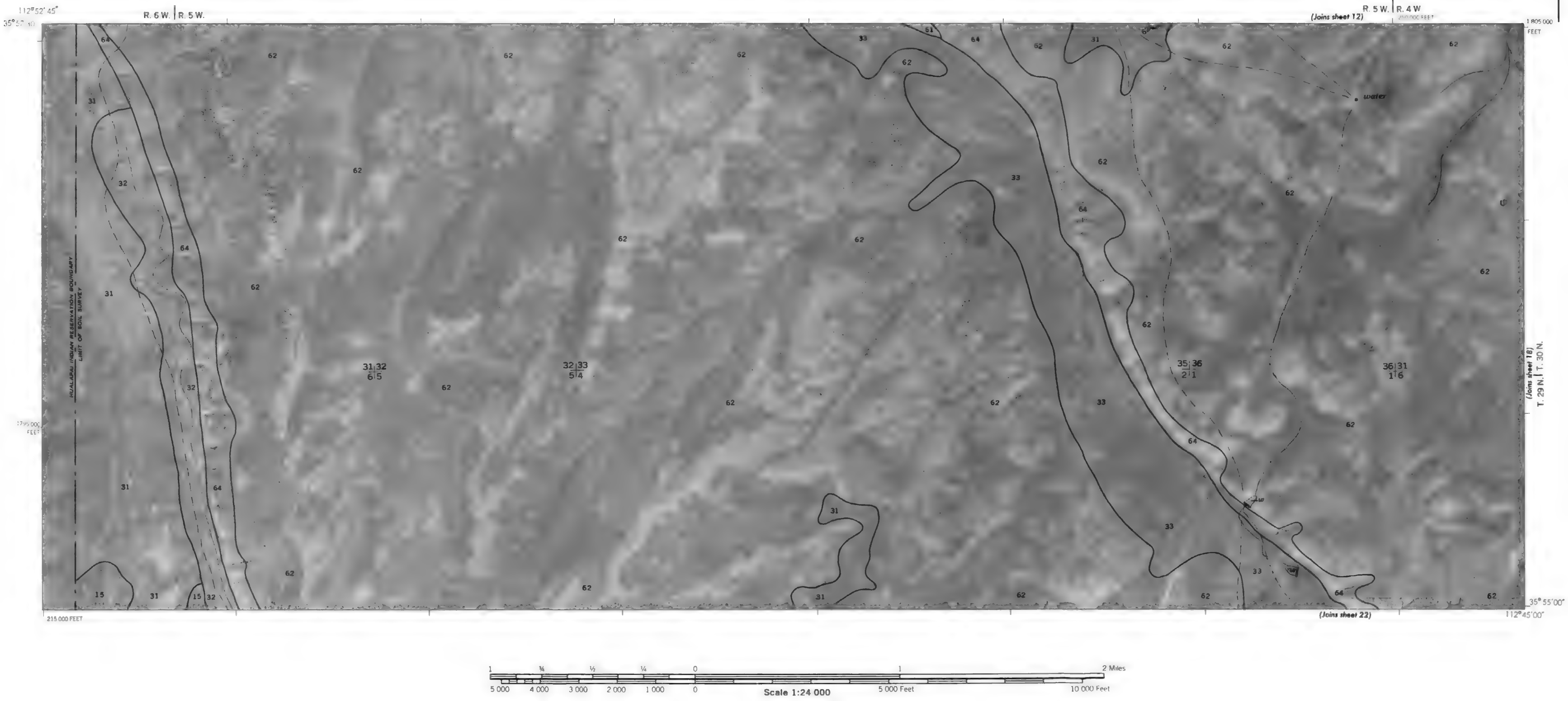

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 17

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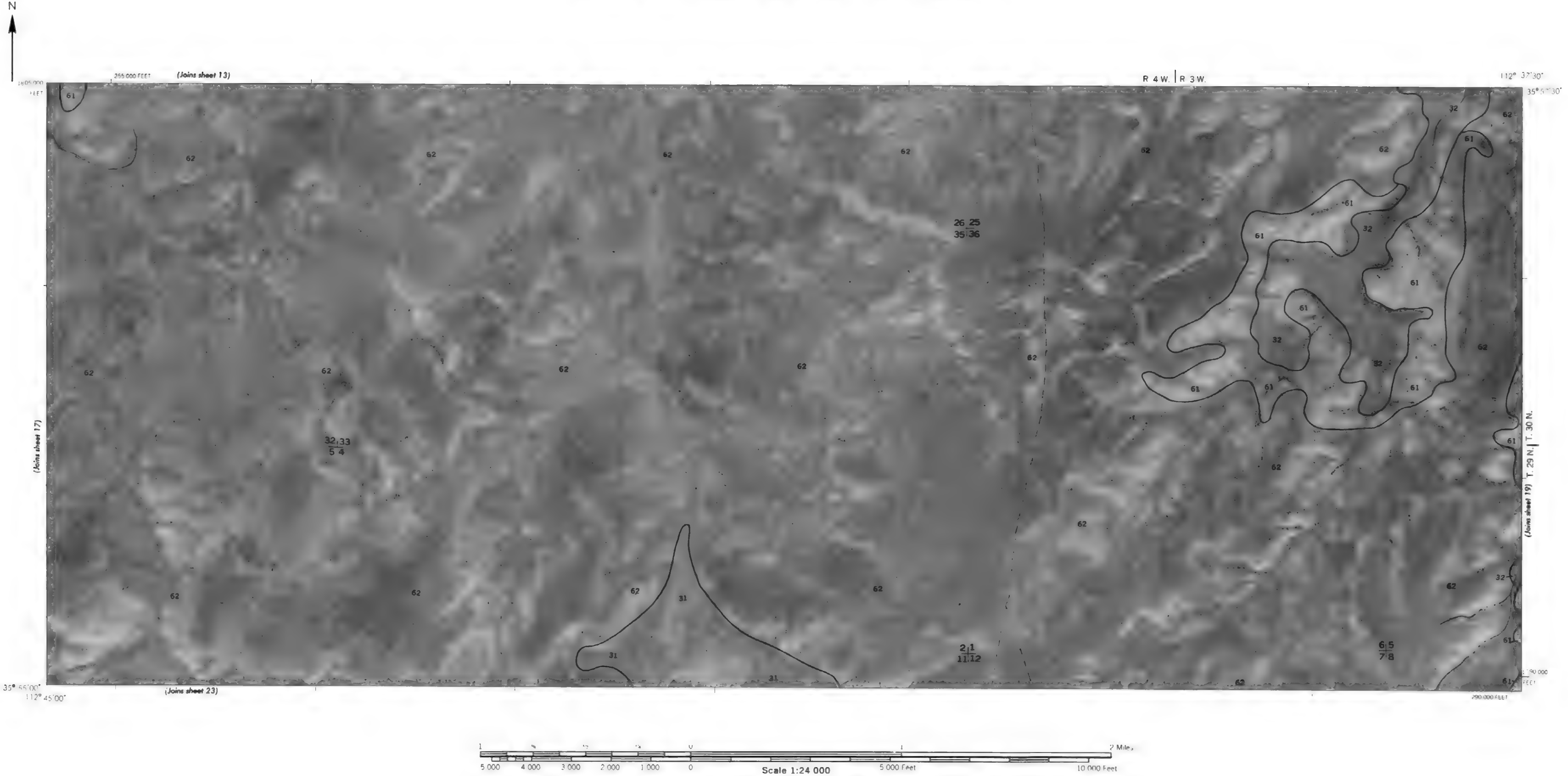
COCONINO COUNTY, ARIZONA, CENTRAL PART — SHEET NUMBER 18



5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

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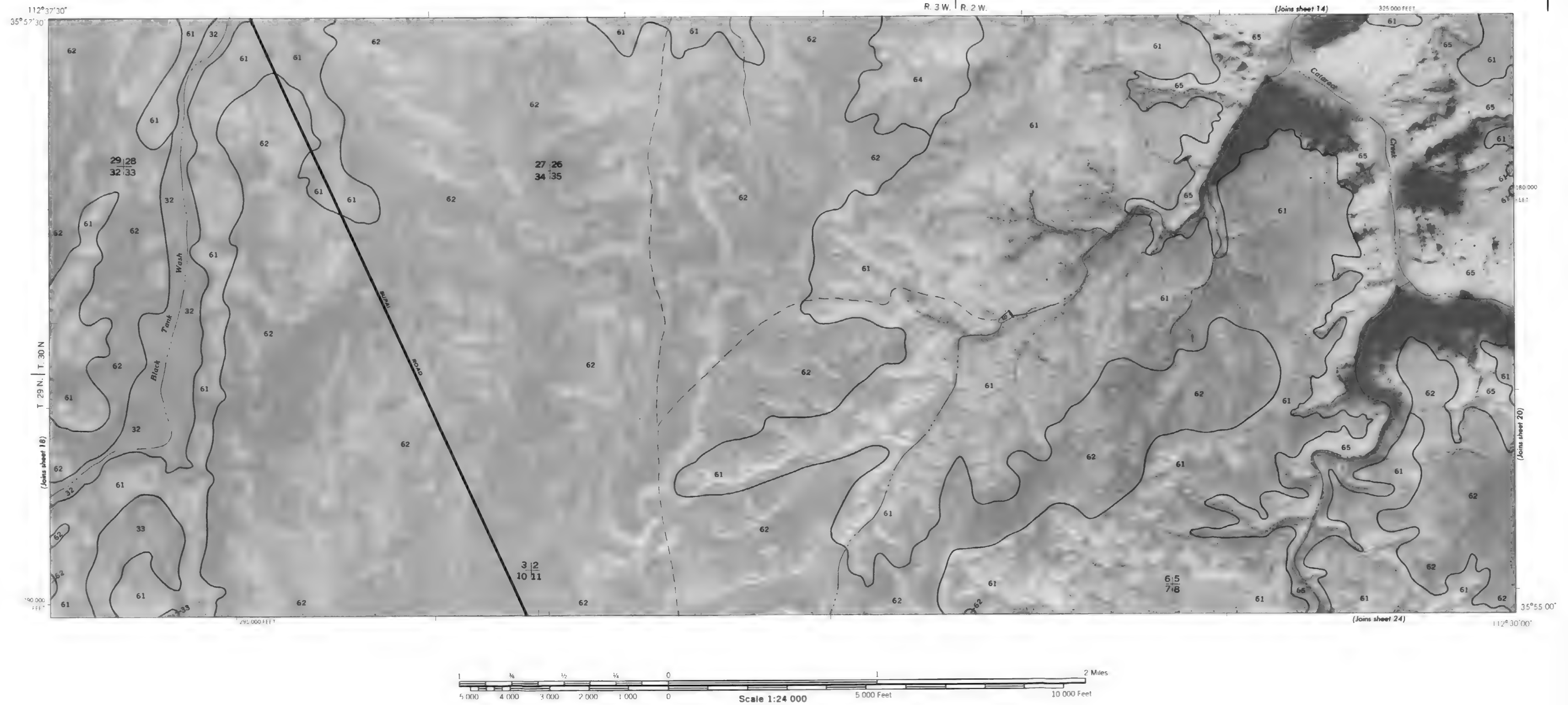

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 19

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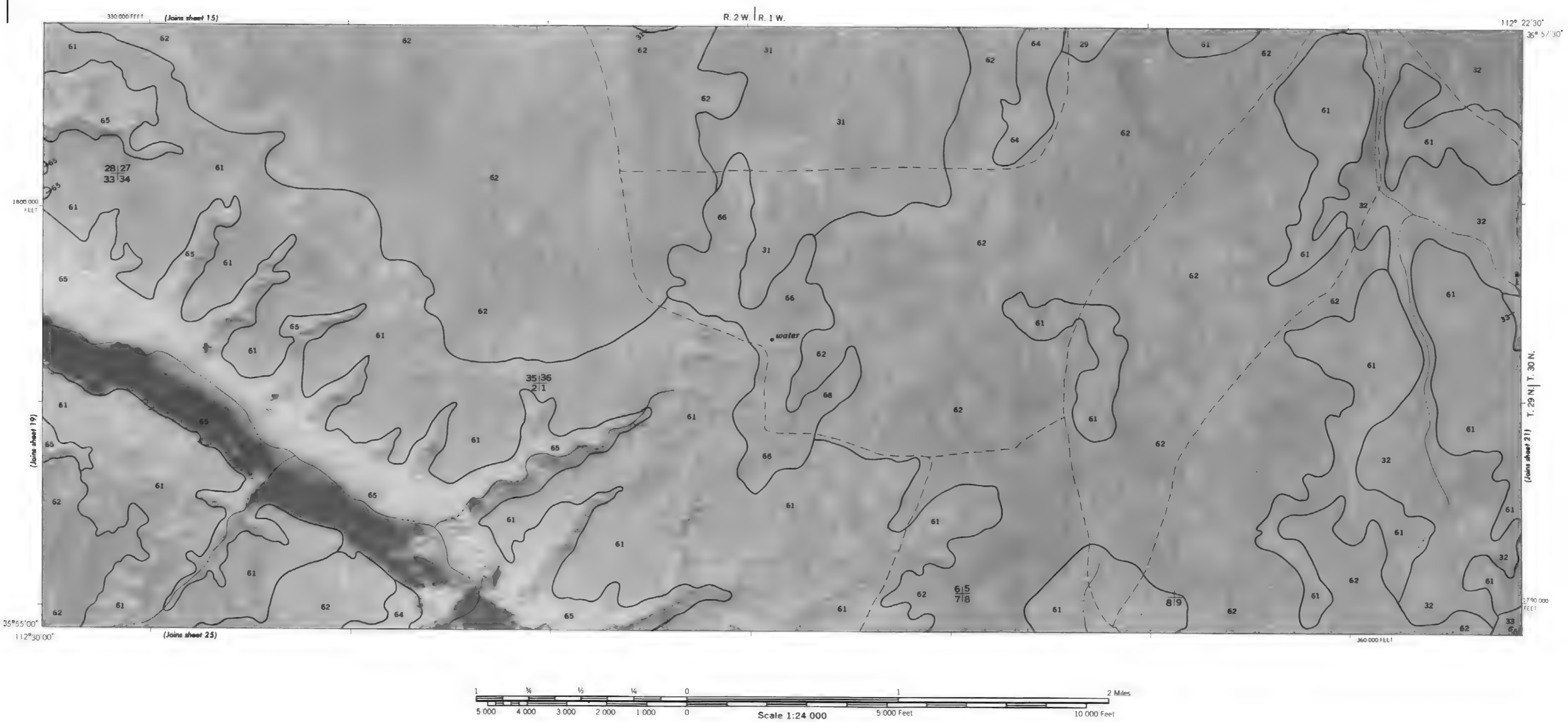
COCONINO COUNTY, ARIZONA, CENTRAL PART — SHEET NUMBER 20



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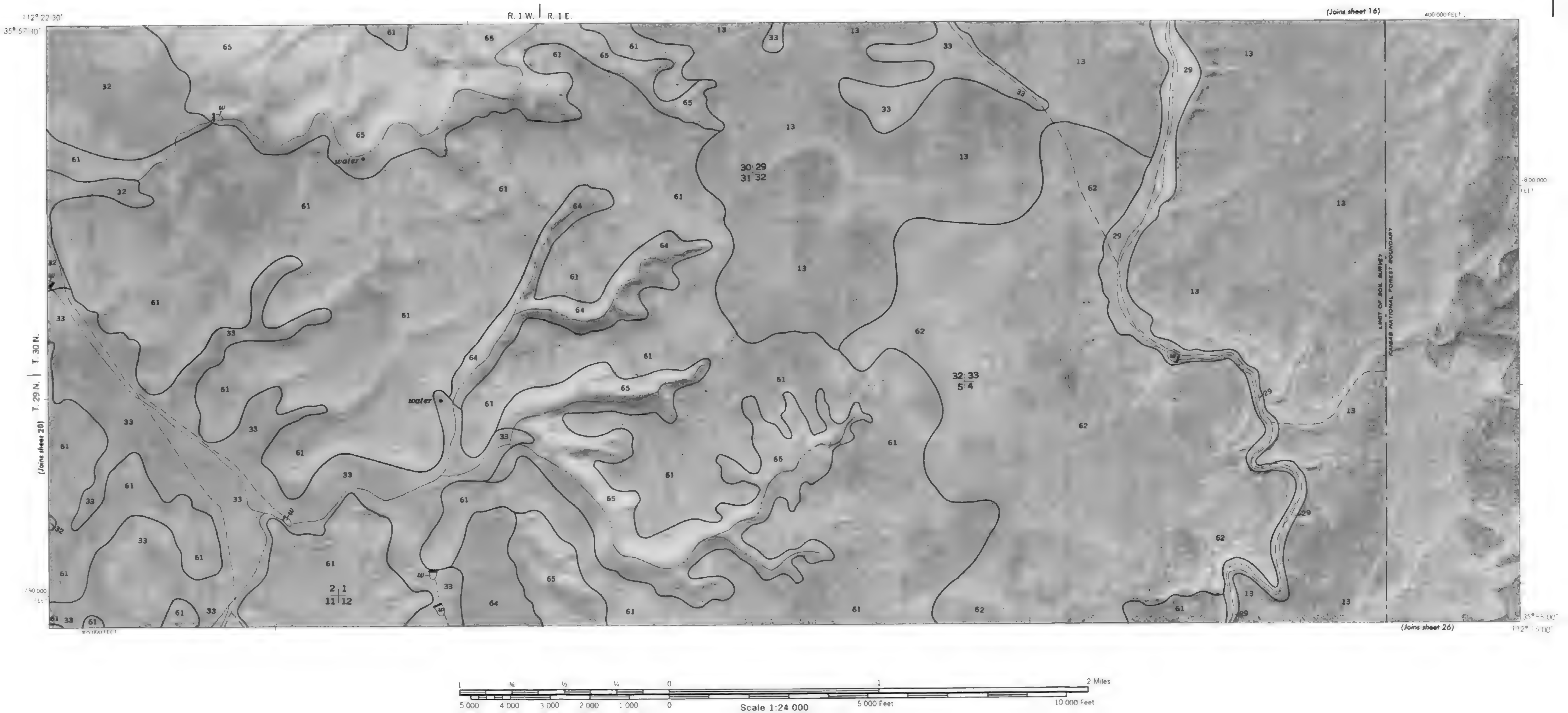
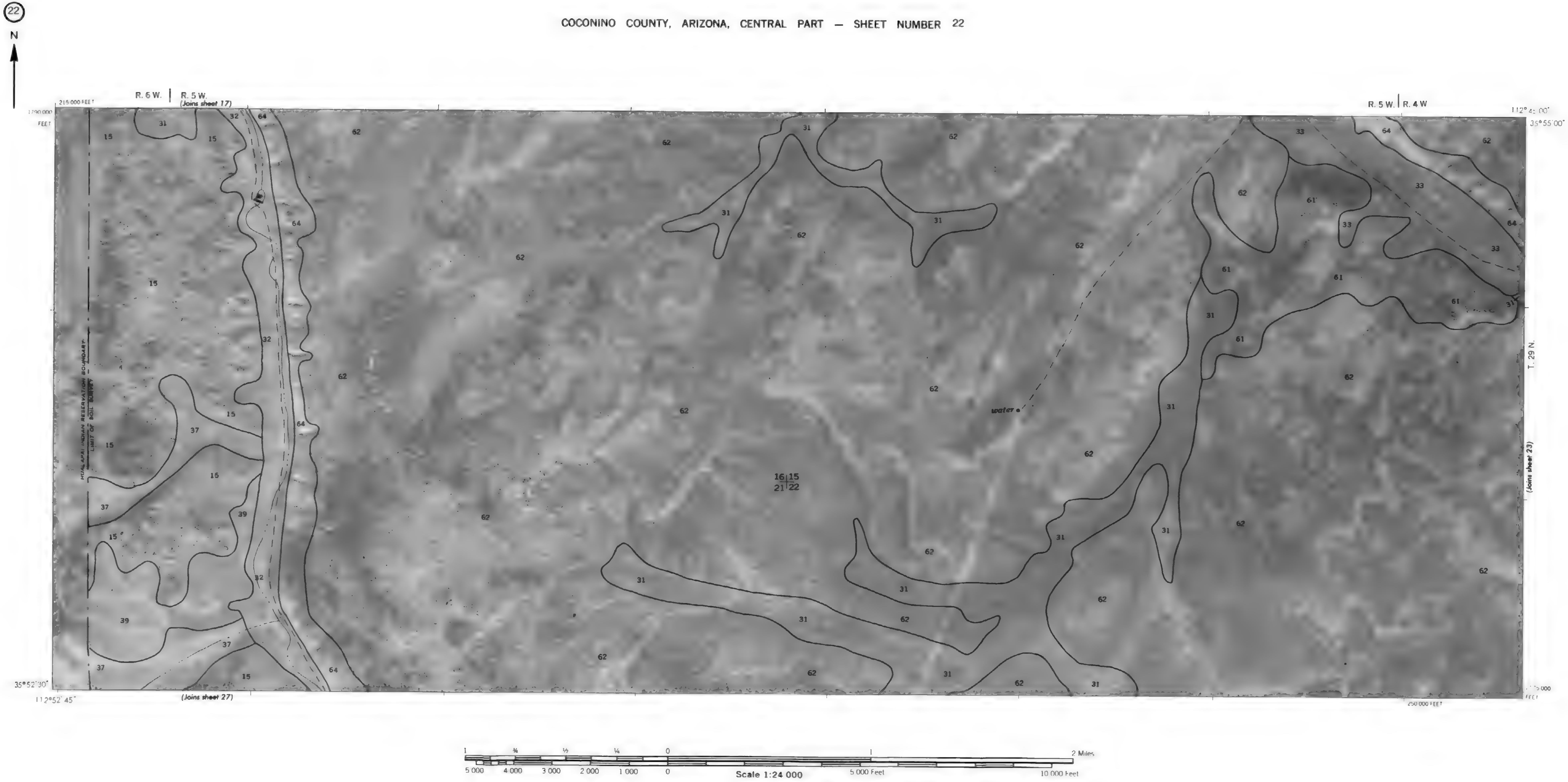
COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 20



COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 21

This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotography by the U.S. Department of Agriculture Soil Conservation Service and cooperating agencies. 5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

COCONINO COUNTY, ARIZONA, CENTRAL PART — SHEET NUMBER 22



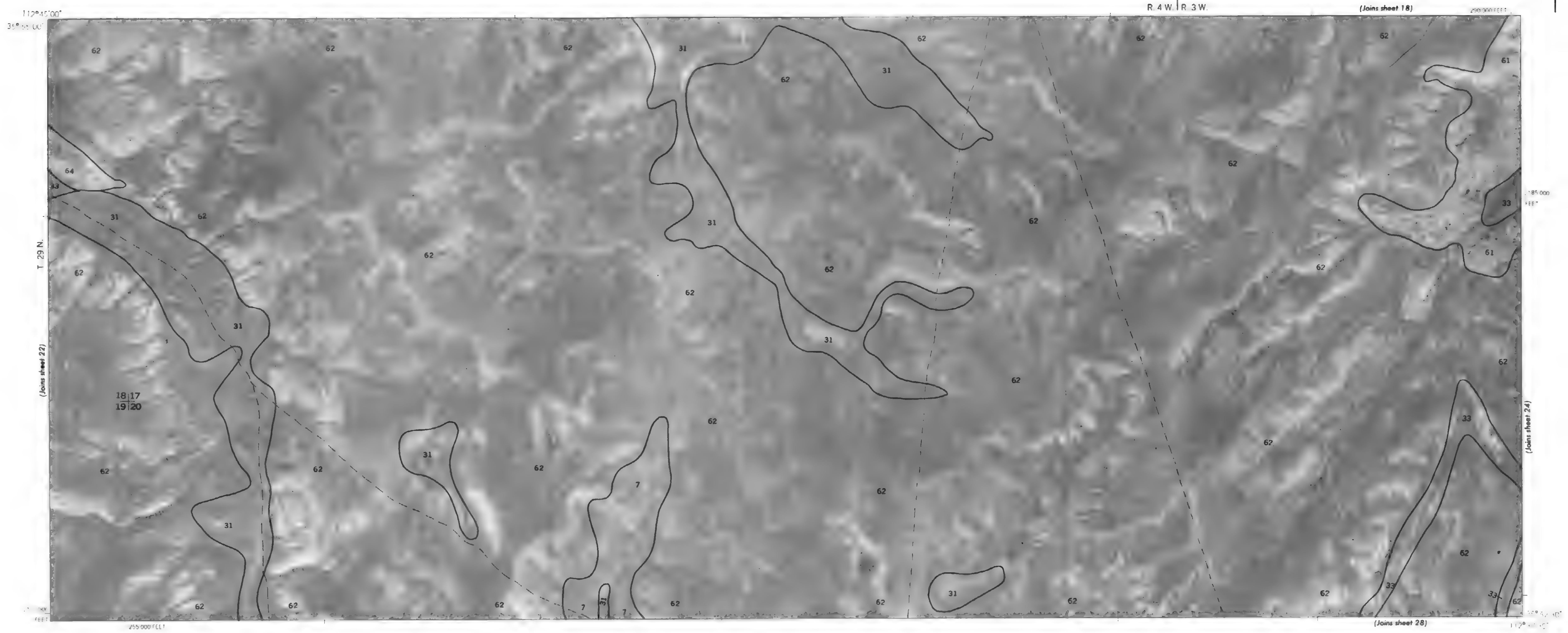
5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.
This map was compiled on 1972 and 1973 U.S. Department of the Interior, Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 22

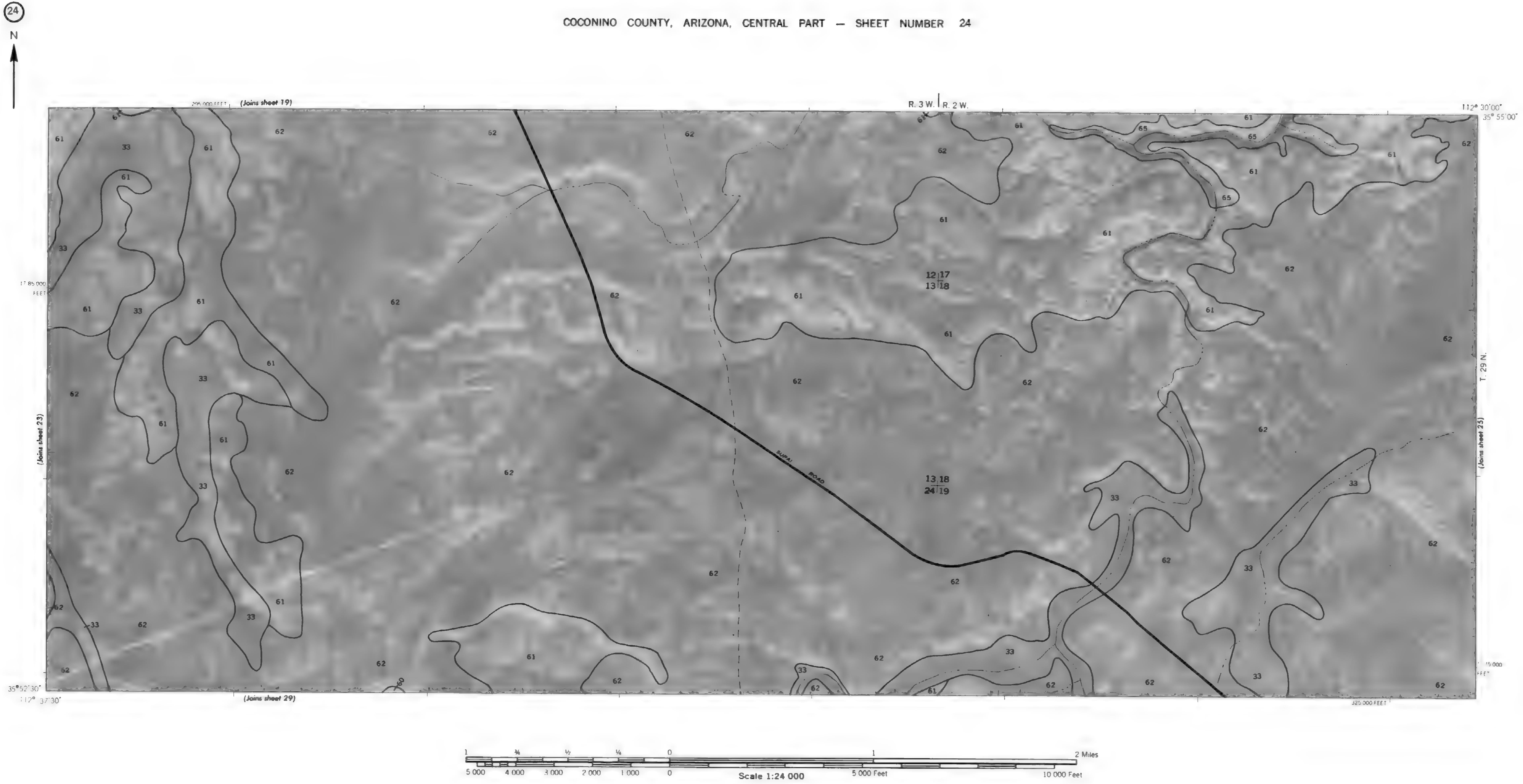
23

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 23

This map was compiled on 1972 and 1973 U.S. Department of The Interior Geological Survey orthophotography by the U.S. Department of Agriculture Soil Conservation Service and cooperating agencies
5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned



1 ½ ¼ 0 1 2 Miles
5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet
Scale 1:24 000



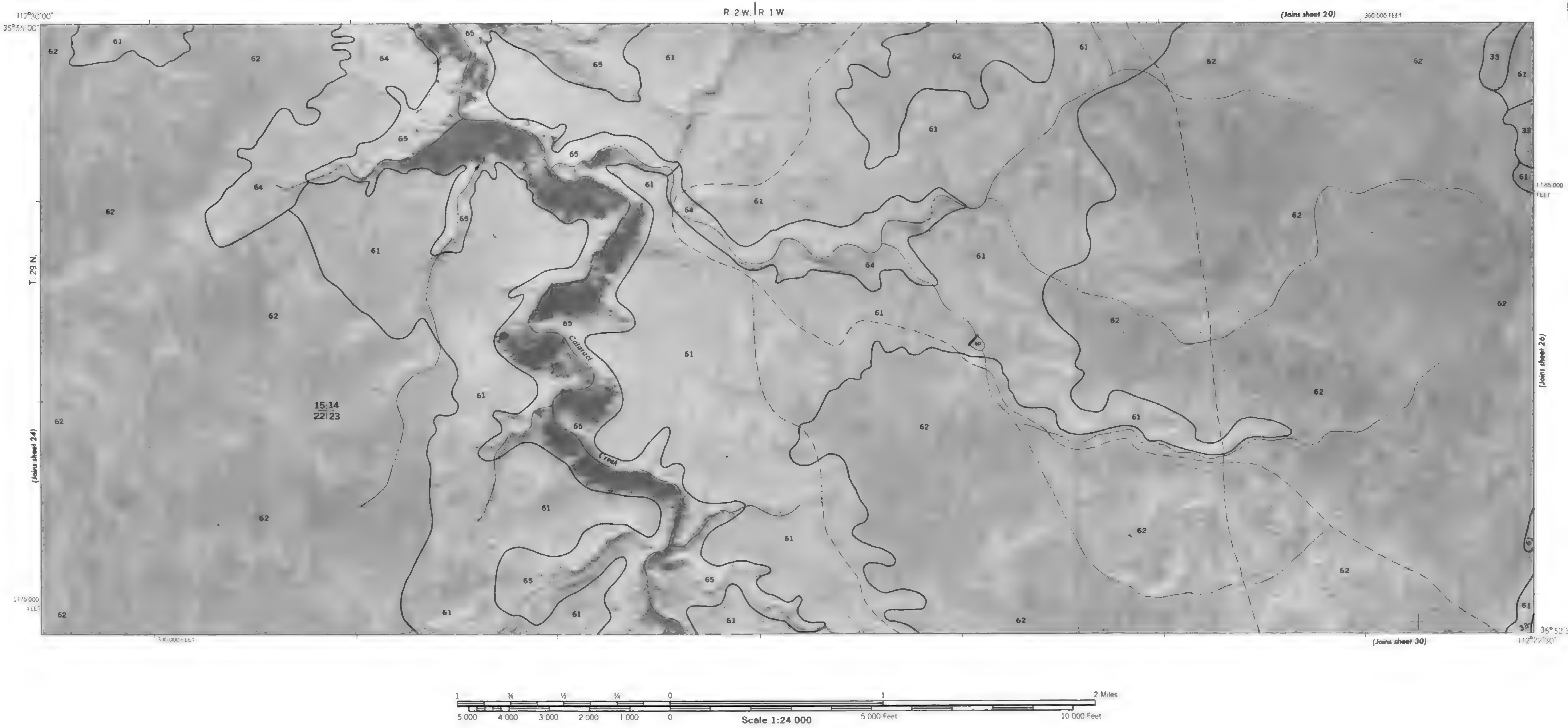
5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.
This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

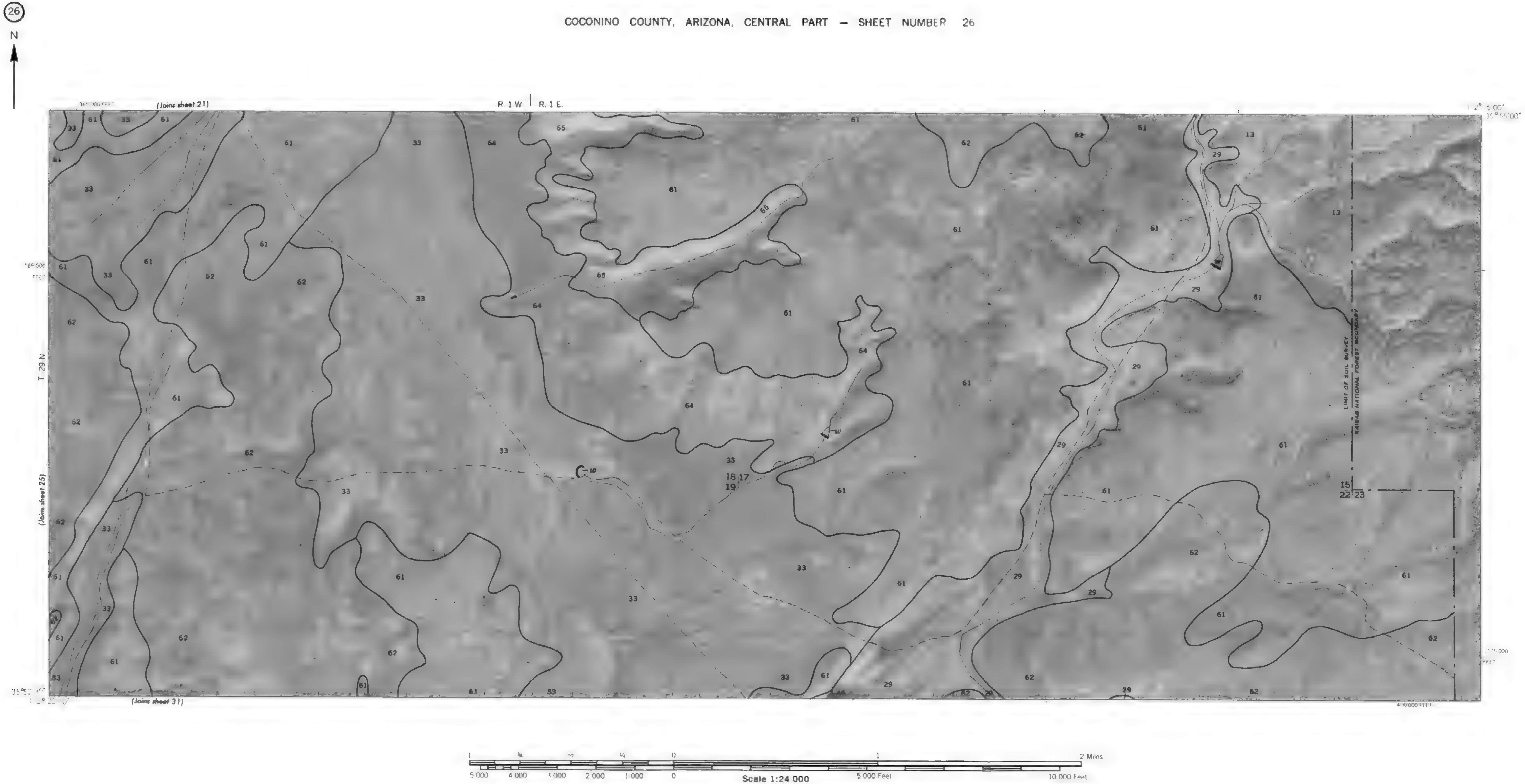
COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 24

25

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 25

This map was compiled on 1972 and 1973 U.S. Department of The Interior Geological Survey orthophotography by the U.S. Department of Agriculture Soil Conservation Service and cooperating agencies.
5 000 foot grid ticks based on state coordinate system. Land division corners if shown are approximately positioned.





5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

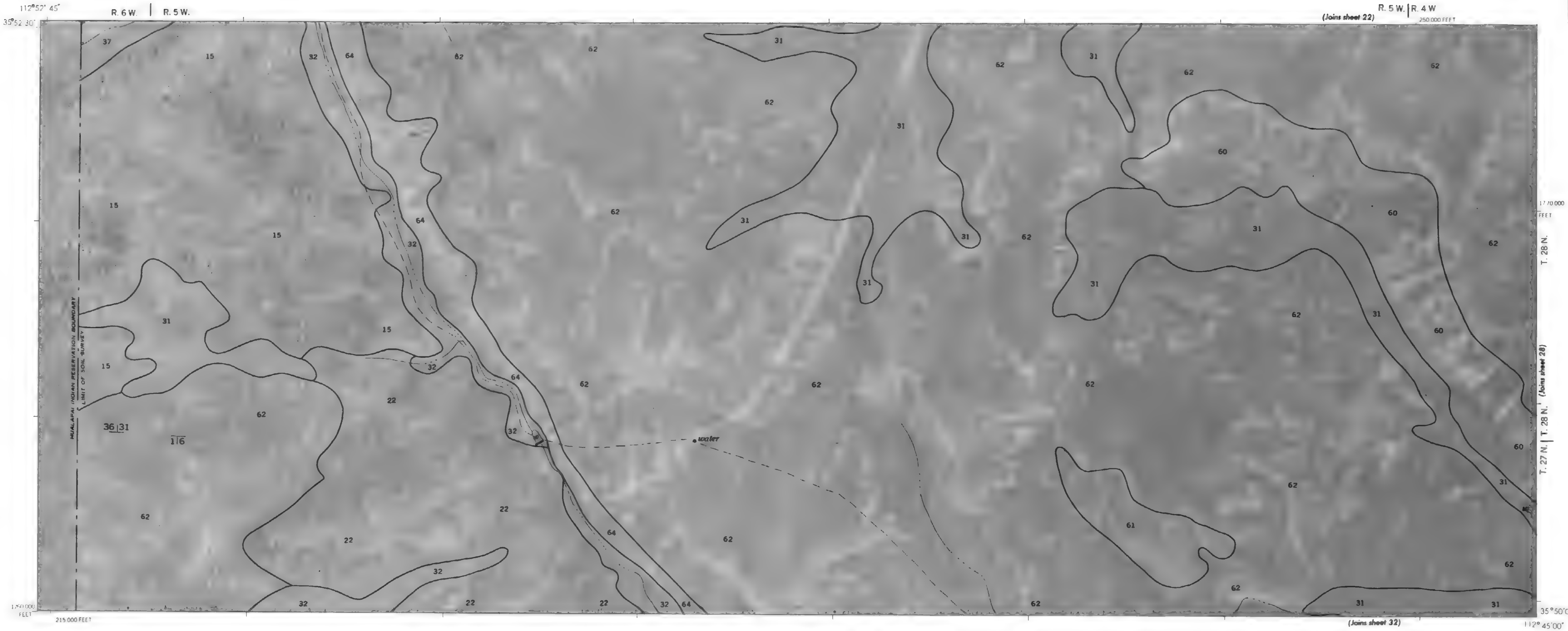
This map was compiled on 1972 and 1973 U.S. Department of the Interior, Geological Survey, orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

27

N

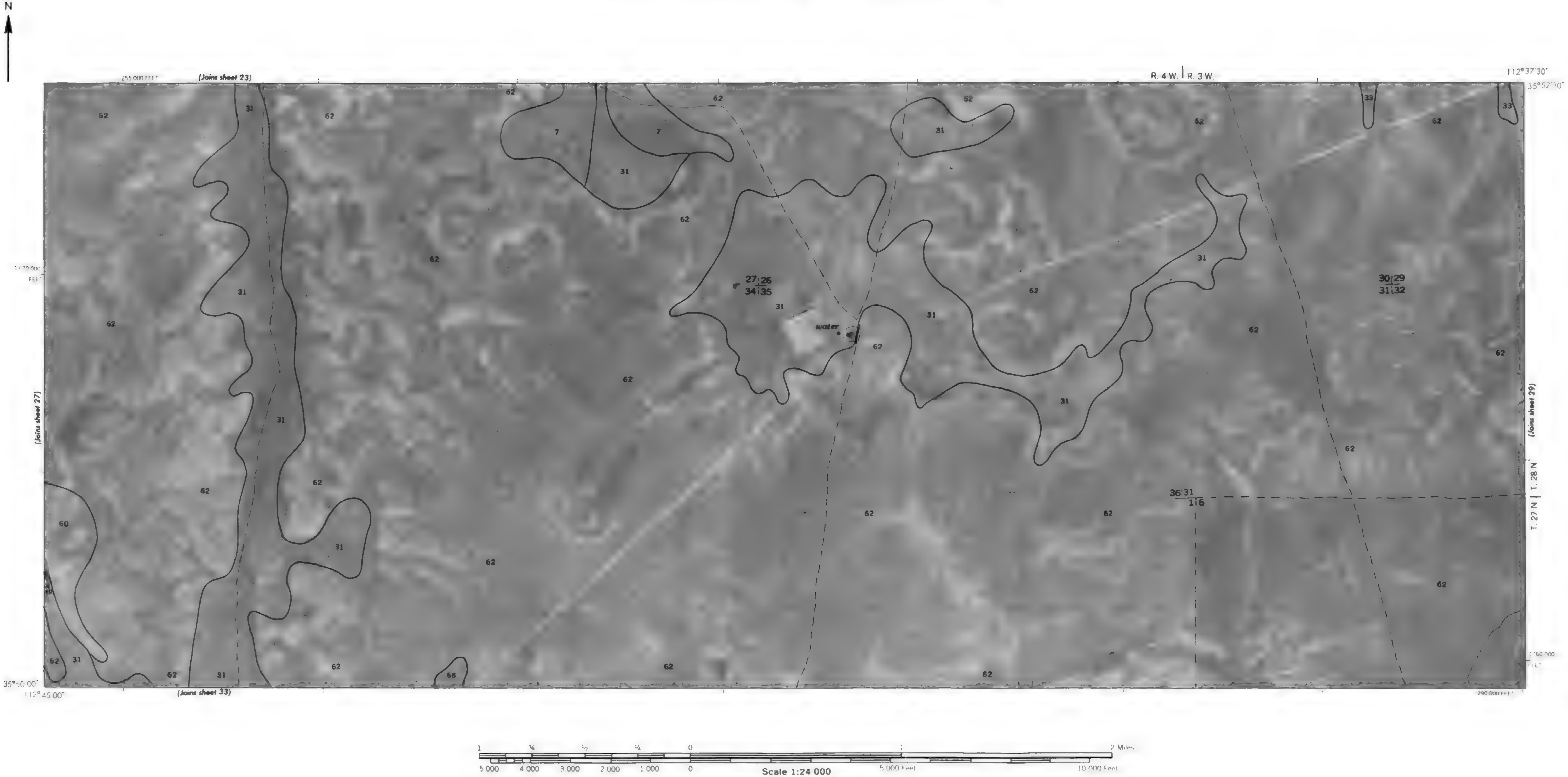
COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 27

This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5 000 foot grid ticks based on state coordinate system. Land division corners if shown are approximately positioned.



1 ¾ ½ ¼ 0 1 2 Miles
5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet
Scale 1:24 000

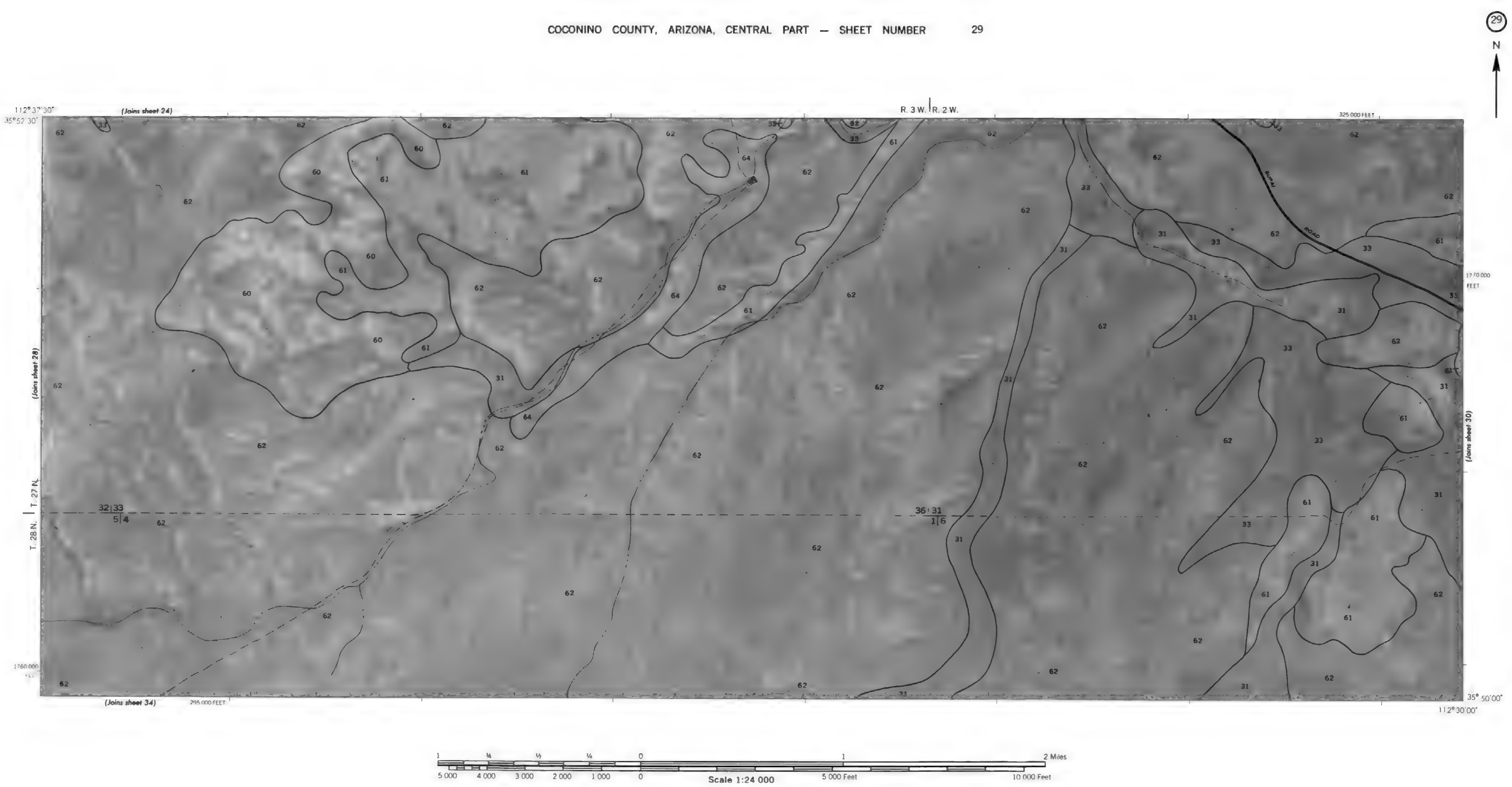
COCONINO COUNTY, ARIZONA, CENTRAL PART — SHEET NUMBER 28

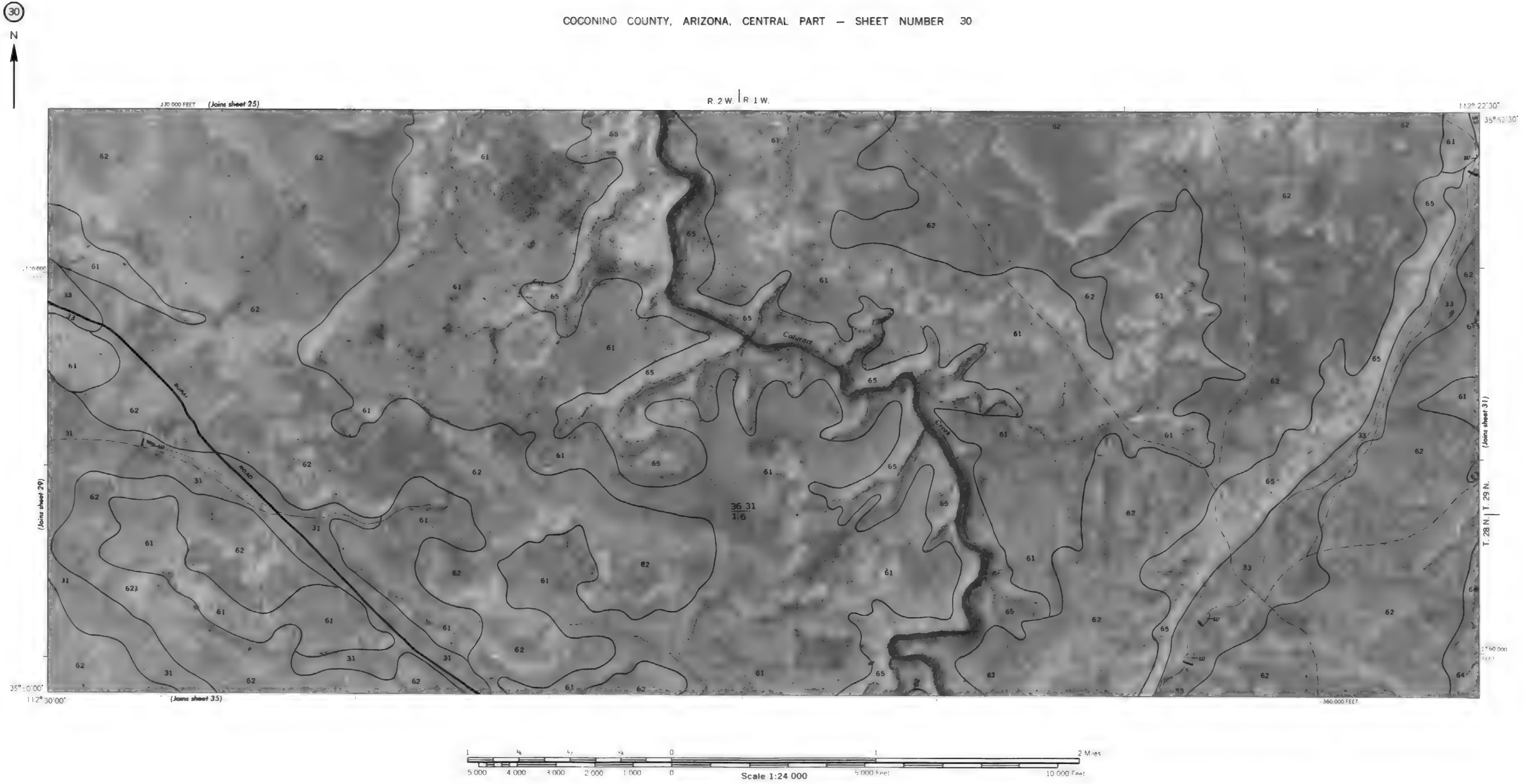


COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 28

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 29

This map was compiled on 1972 and 1973 U.S. Department of The Interior Geological Survey orthophotography by the U.S. Department of Agriculture Soil Conservation Service and cooperating agencies.
5 000-foot grid ticks based on state coordinate system. Land division corners if shown are approximately positioned.





COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 30

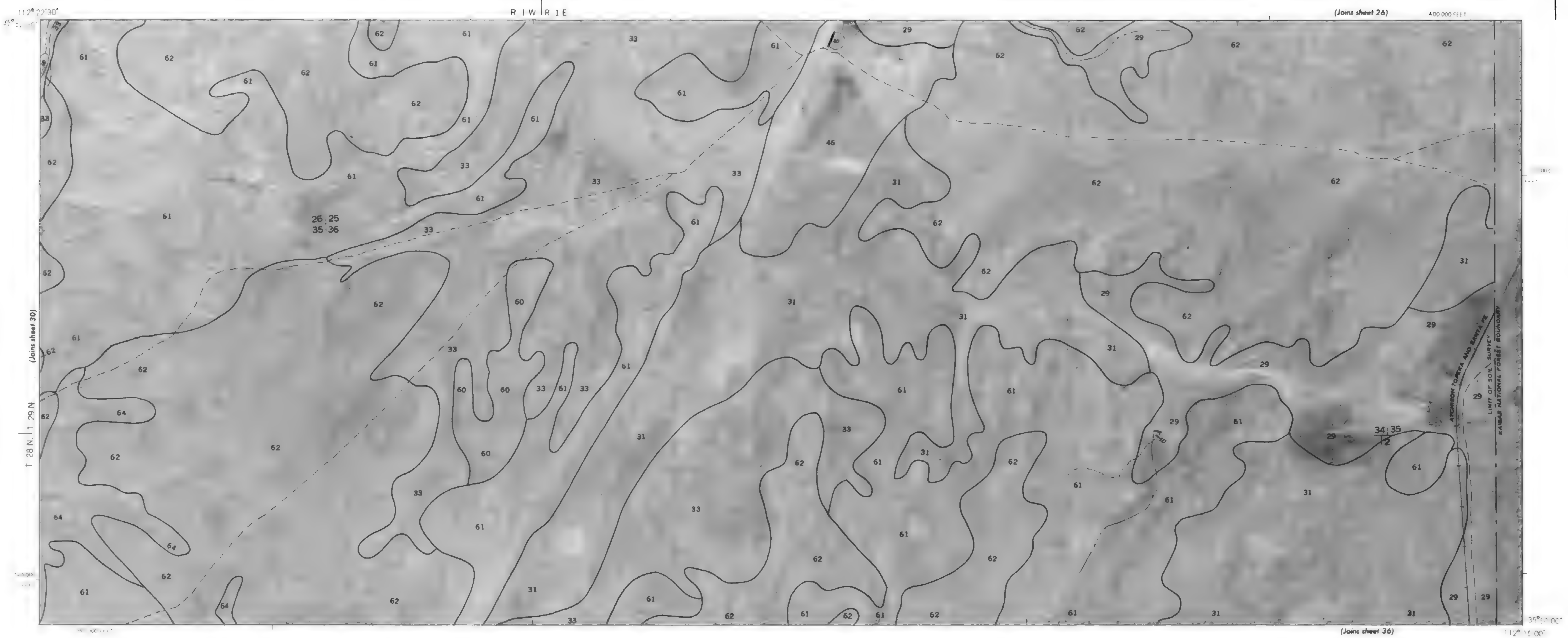
5,000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1972 and 1973 U.S. Department of The Interior Geological Survey orthophotographs by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

31

N

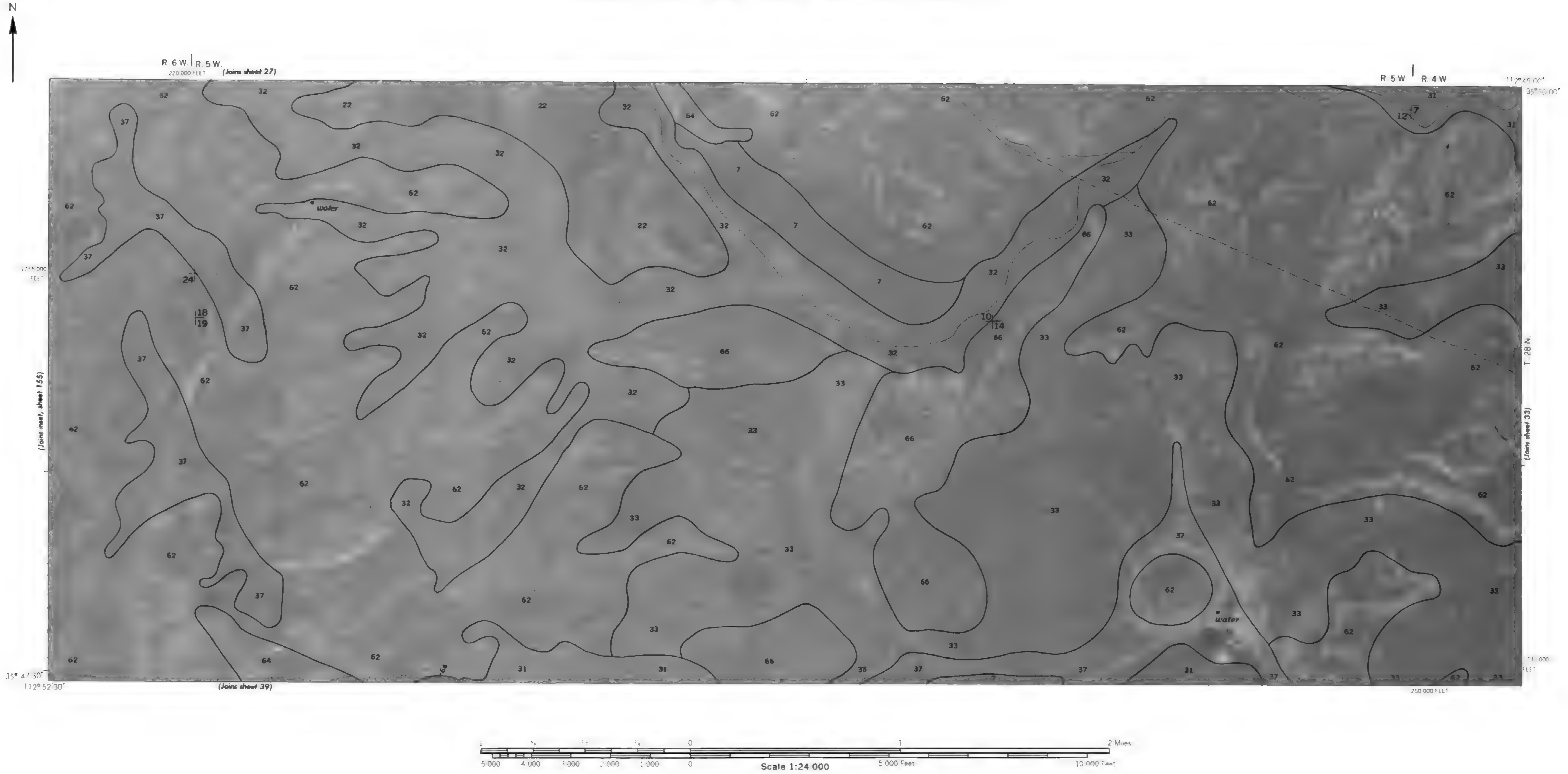
COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 31



1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000



5 000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

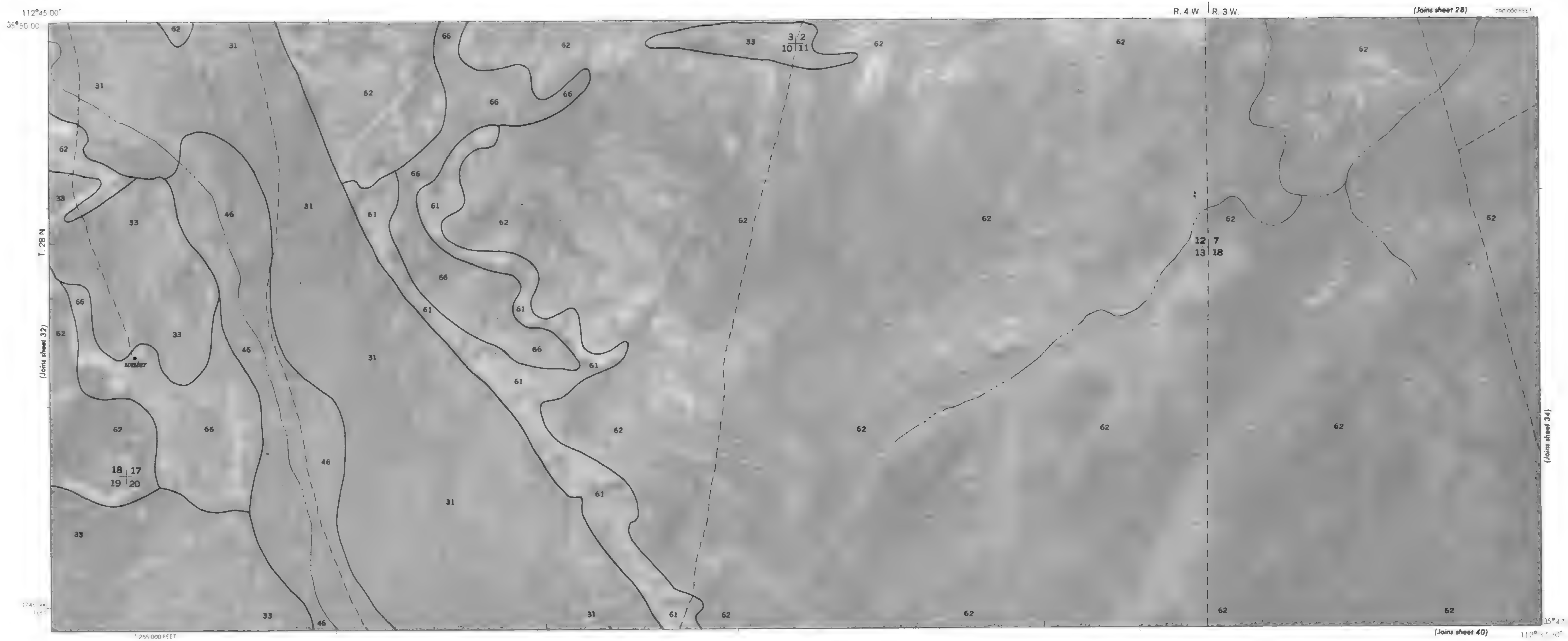
This map was compiled on 1972 and 1973 U.S. Department of The Interior, Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

33

N

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 33

This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000 foot grid ticks based on state coordinate system. Land division corners if shown are approximately positioned.

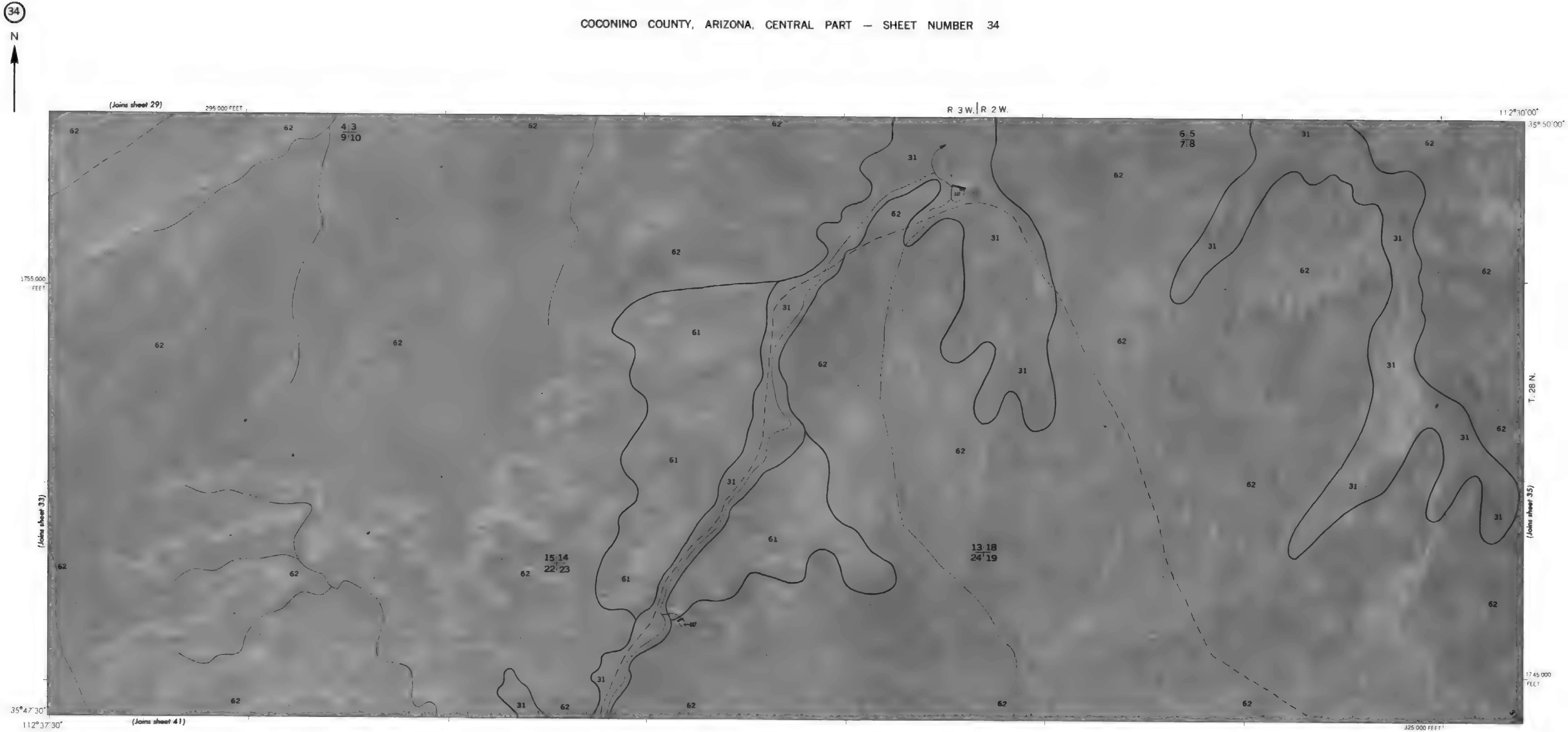


Scale 1:24 000

1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 4 000 2 000 1 000 0 5 000 Feet 10 000 Feet

COCONINO COUNTY, ARIZONA, CENTRAL PART — SHEET NUMBER 34



1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

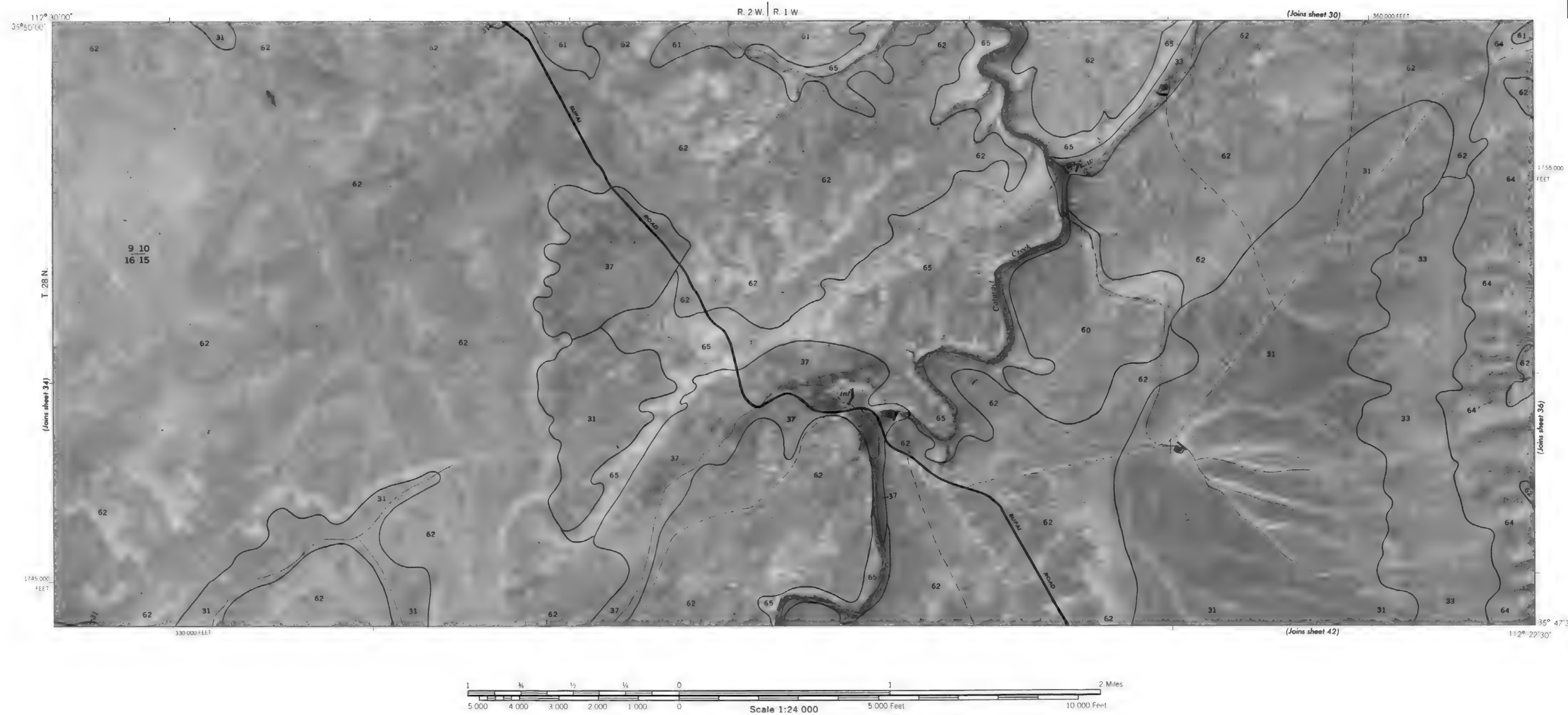
COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 34

35

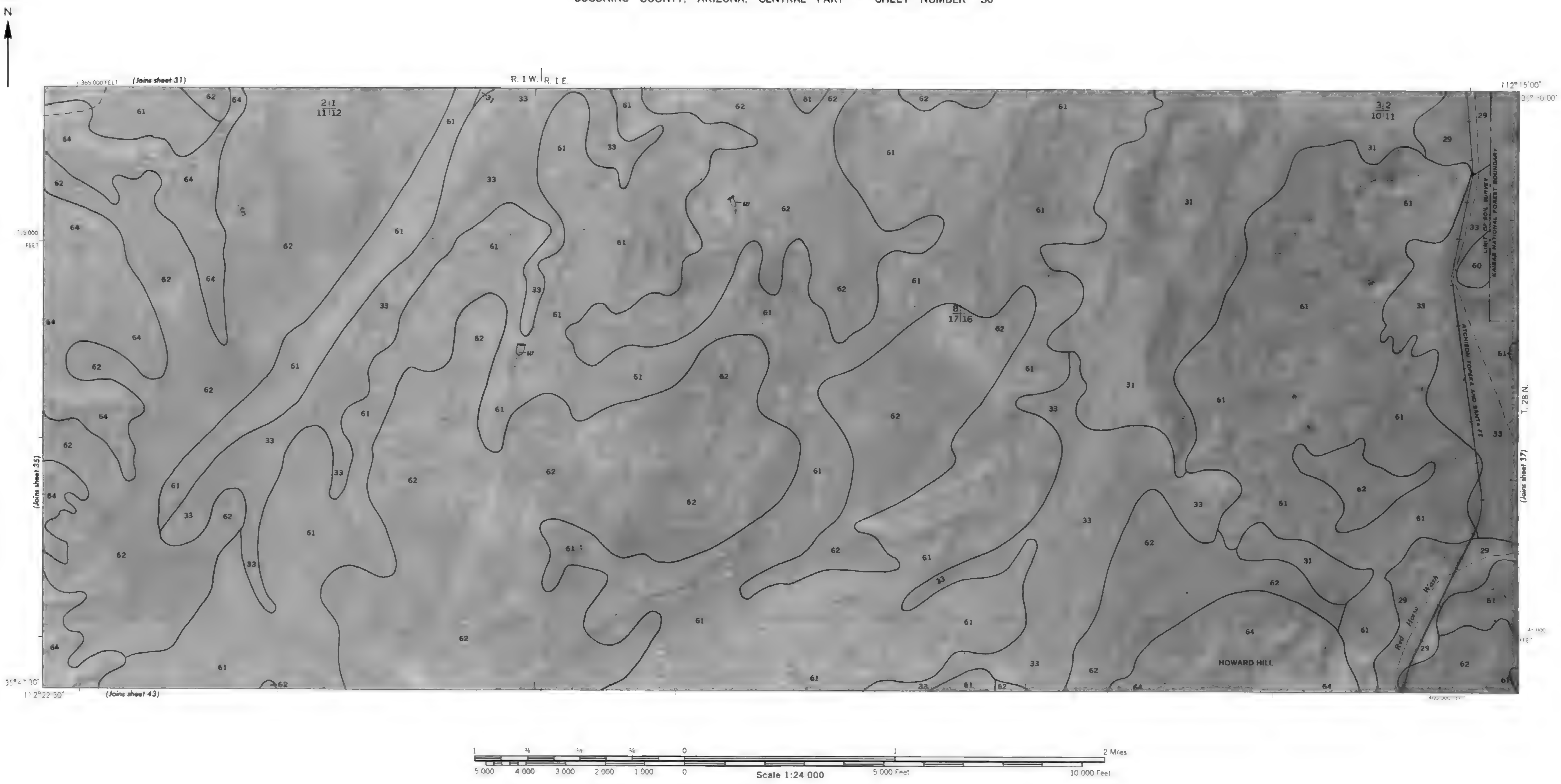
N

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 35

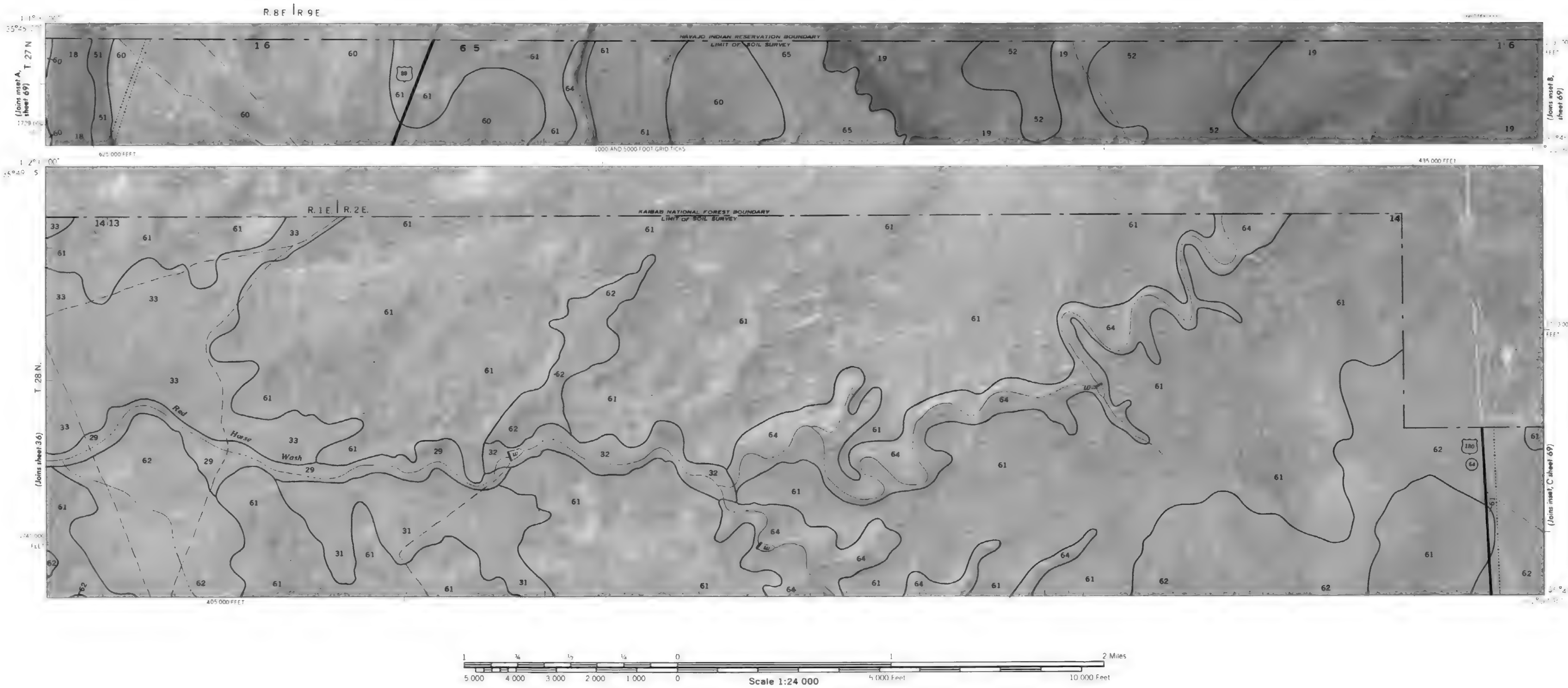
This map was compiled on 1972 and 1978 U.S. Department of The Interior Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.



COCONINO COUNTY, ARIZONA, CENTRAL PART — SHEET NUMBER 36

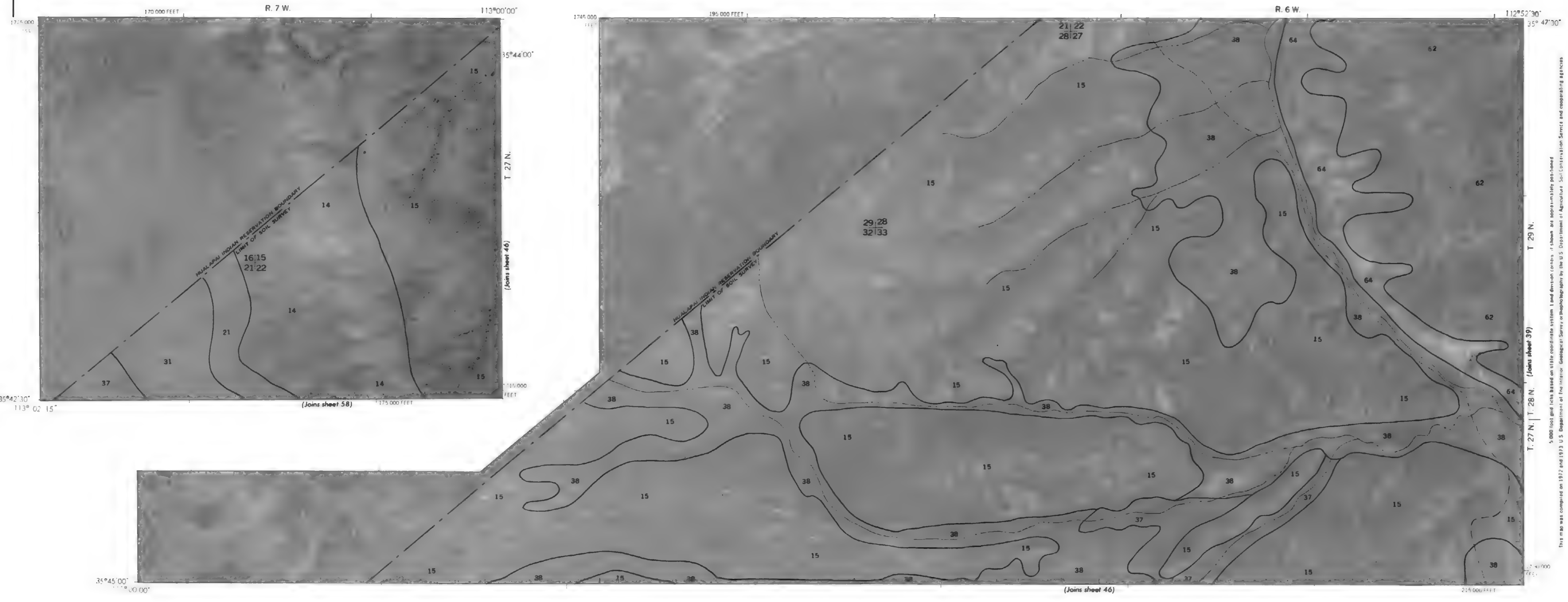


5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.
This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.



This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotography by the U.S. Department of Agriculture Soil Conservation Service and cooperating agencies. 5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

COCONINO COUNTY, ARIZONA, CENTRAL PART — SHEET NUMBER 38



1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

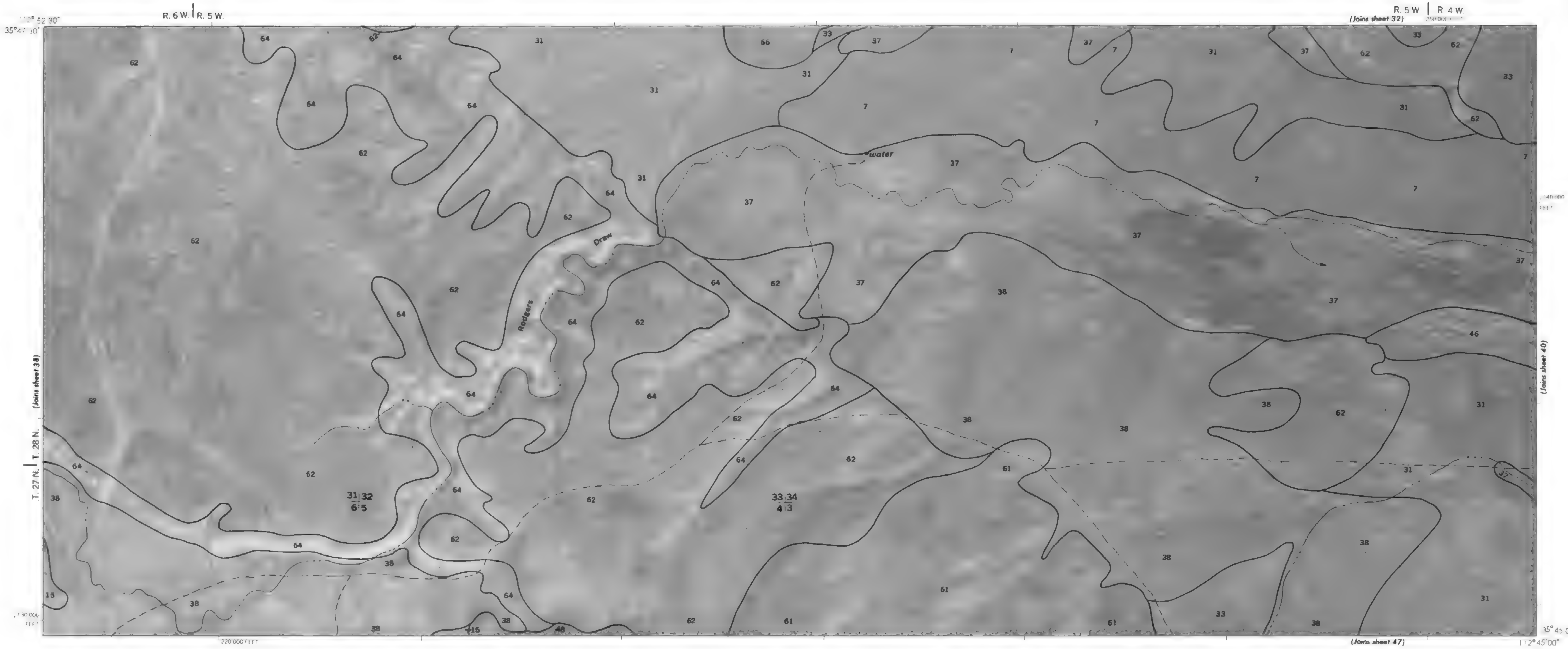
This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5 000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

39

N

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 39

This map was compiled on 1972 and 1973 U.S. Department of the Interior, Geological Survey orthophotographs by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. 5 000-foot grid ticks based on state coordinate system. Land division corners if shown are approximately positioned.

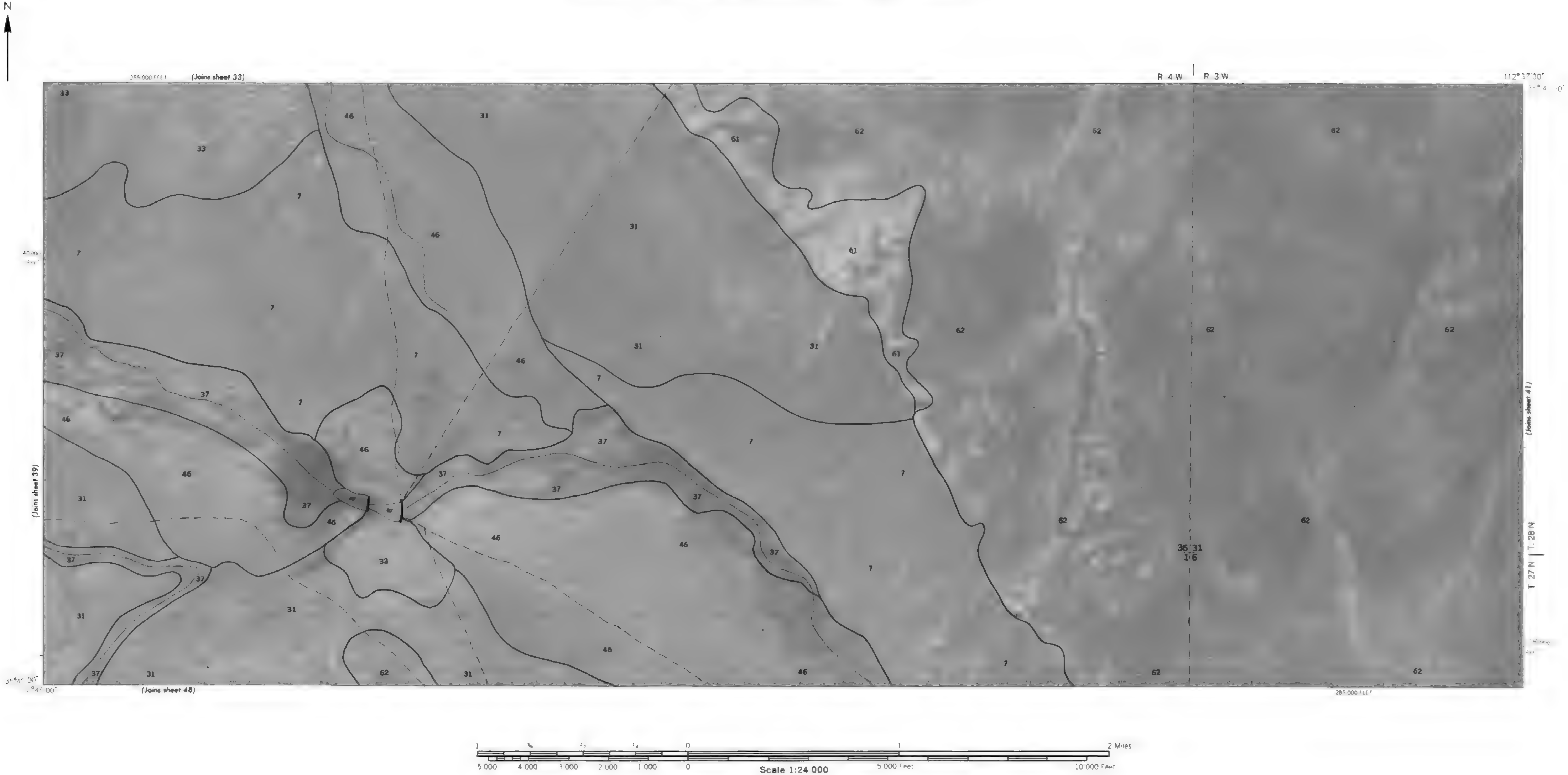


1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

COCONINO COUNTY, ARIZONA, CENTRAL PART — SHEET NUMBER 40



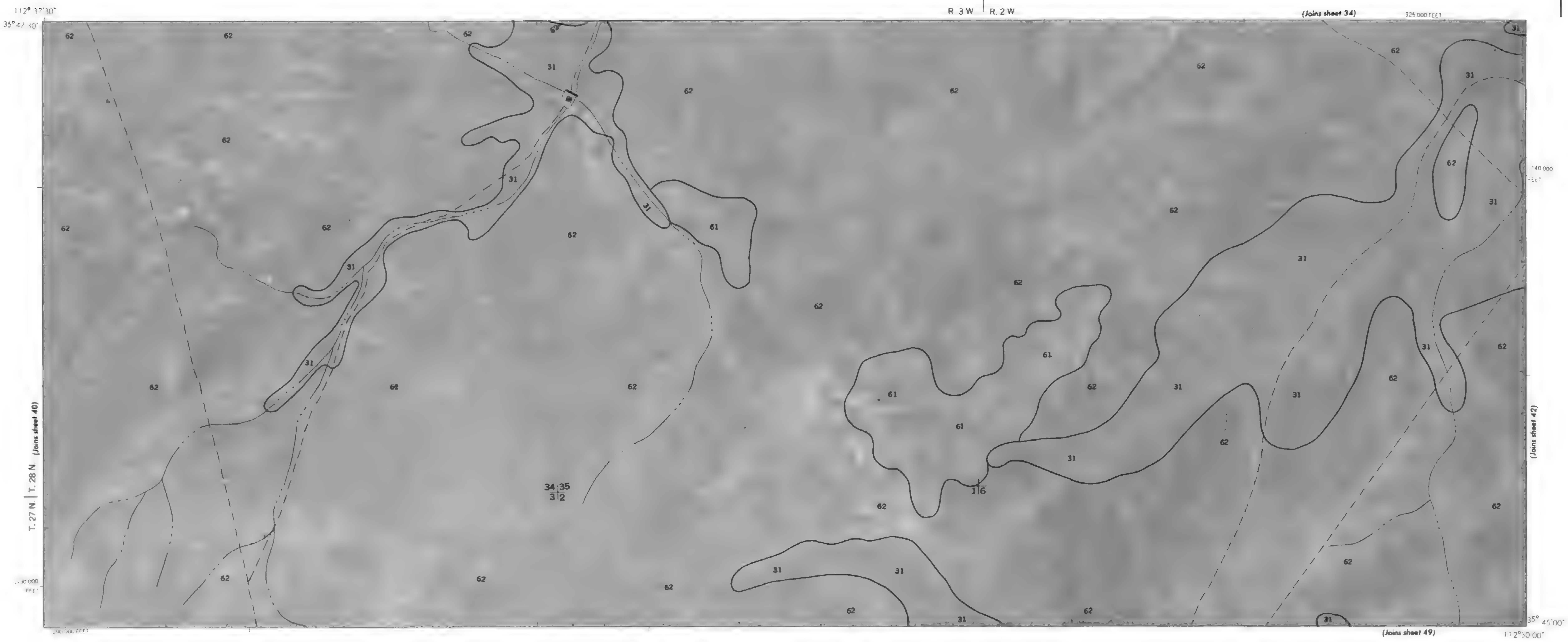
COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 40

41

N

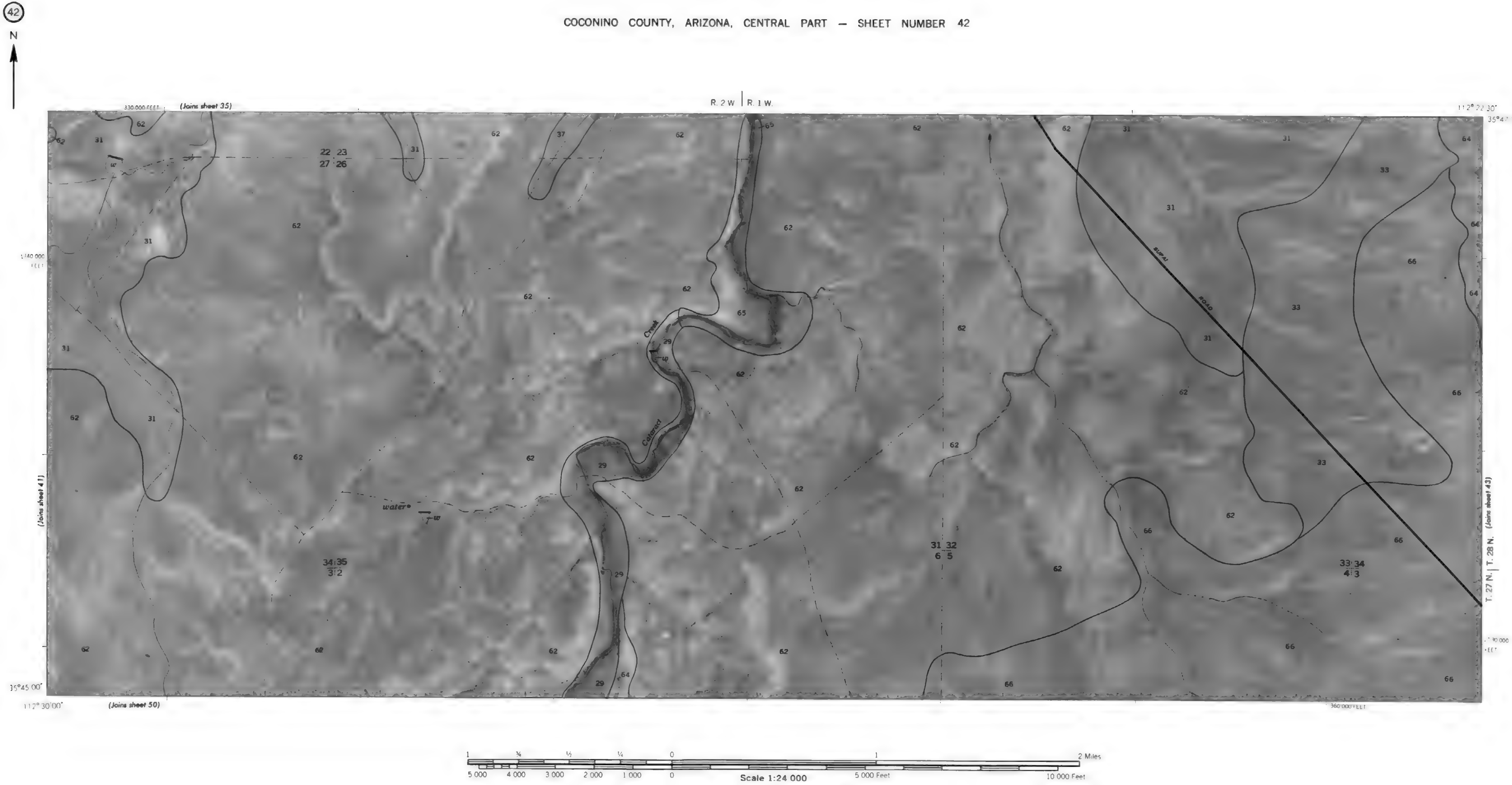
COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 41

This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.



1 ¾ ½ ¼ 0 1 2 Miles
5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet
Scale 1:24 000

COCONINO COUNTY, ARIZONA, CENTRAL PART — SHEET NUMBER 42



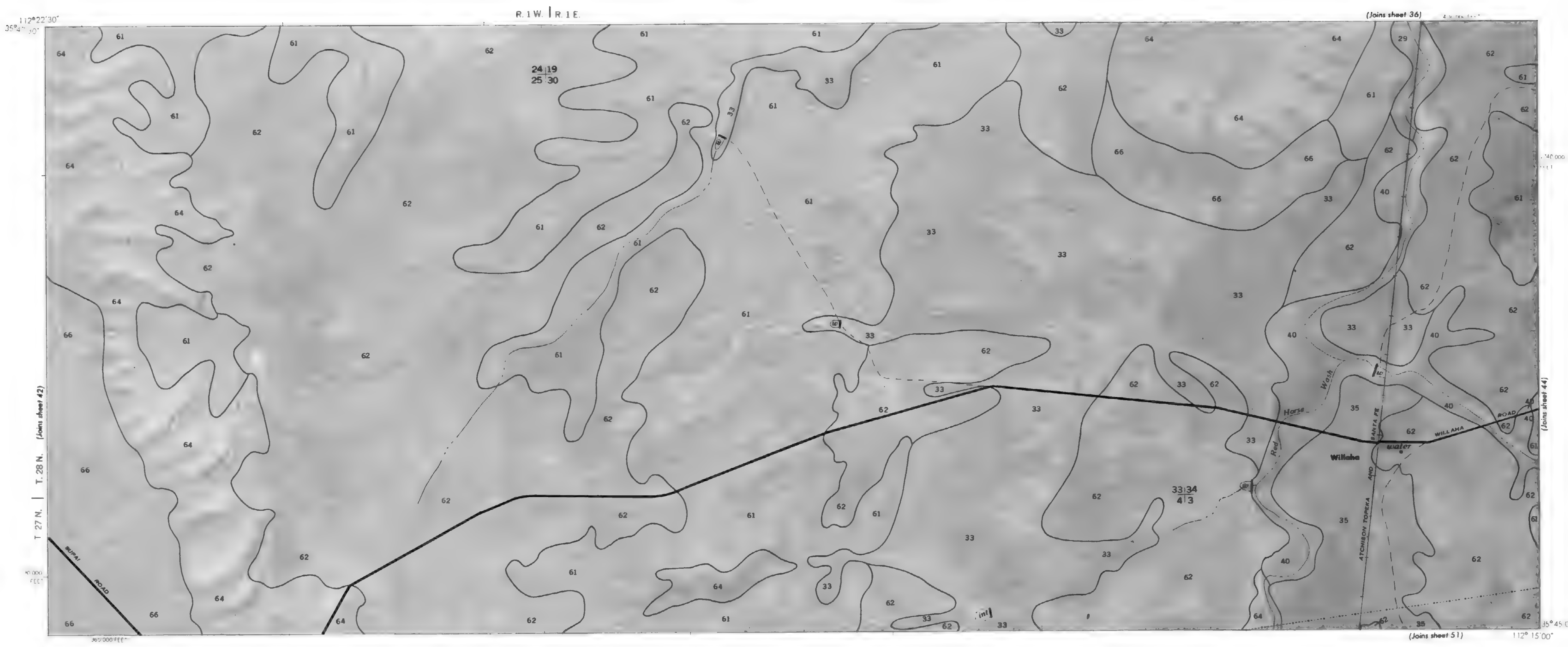
5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1972 and 1973 U.S. Department of the Interior, Geological Survey, orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 42

43

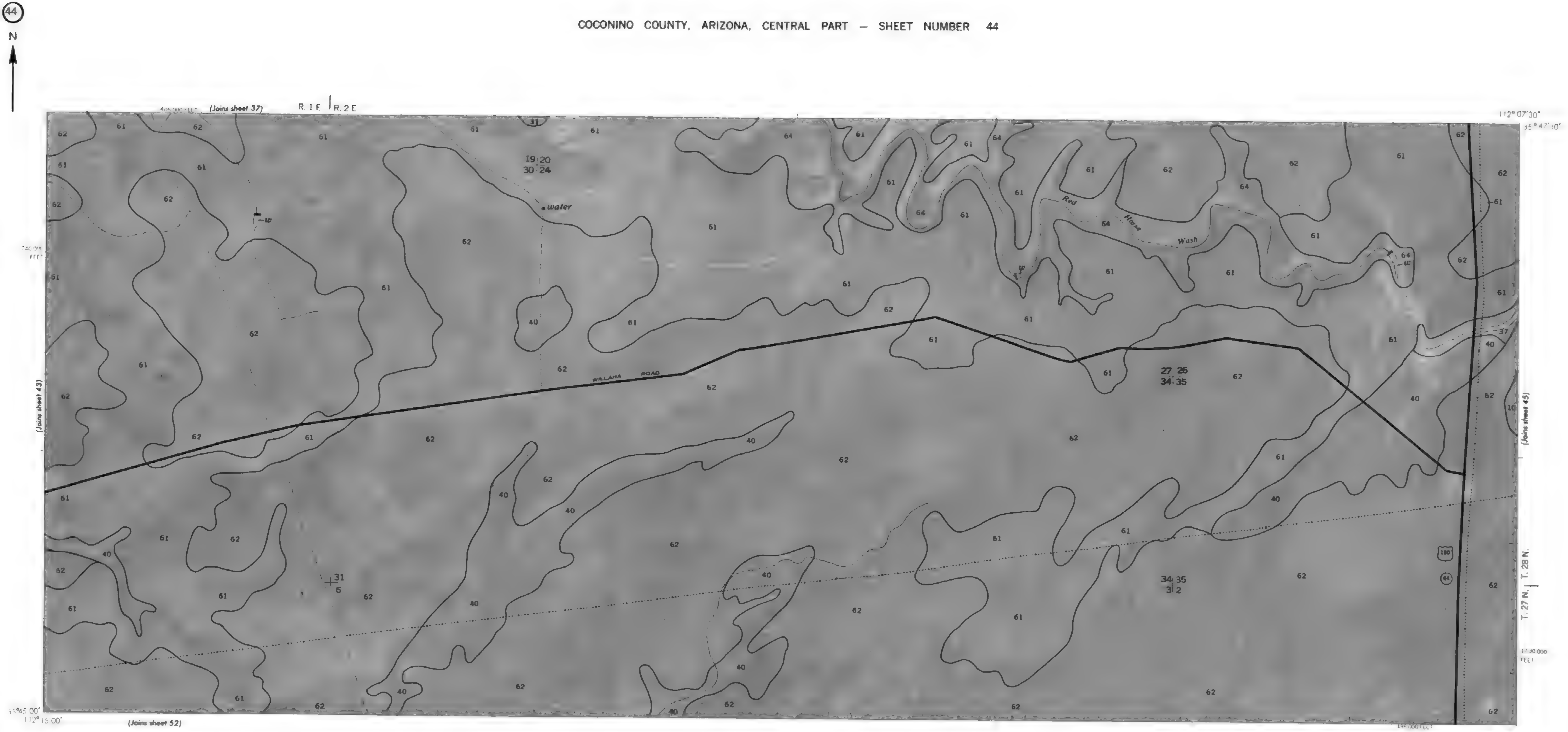
N



COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 43

This map was compiled on 1972 and 1973 U.S. Department of the Interior, Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5 000 foot grid ticks based on state coordinate system. Land division corners if shown are approximately positioned.

1 ¾ ½ ¼ 0 1 2 Miles
5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet
Scale 1:24 000



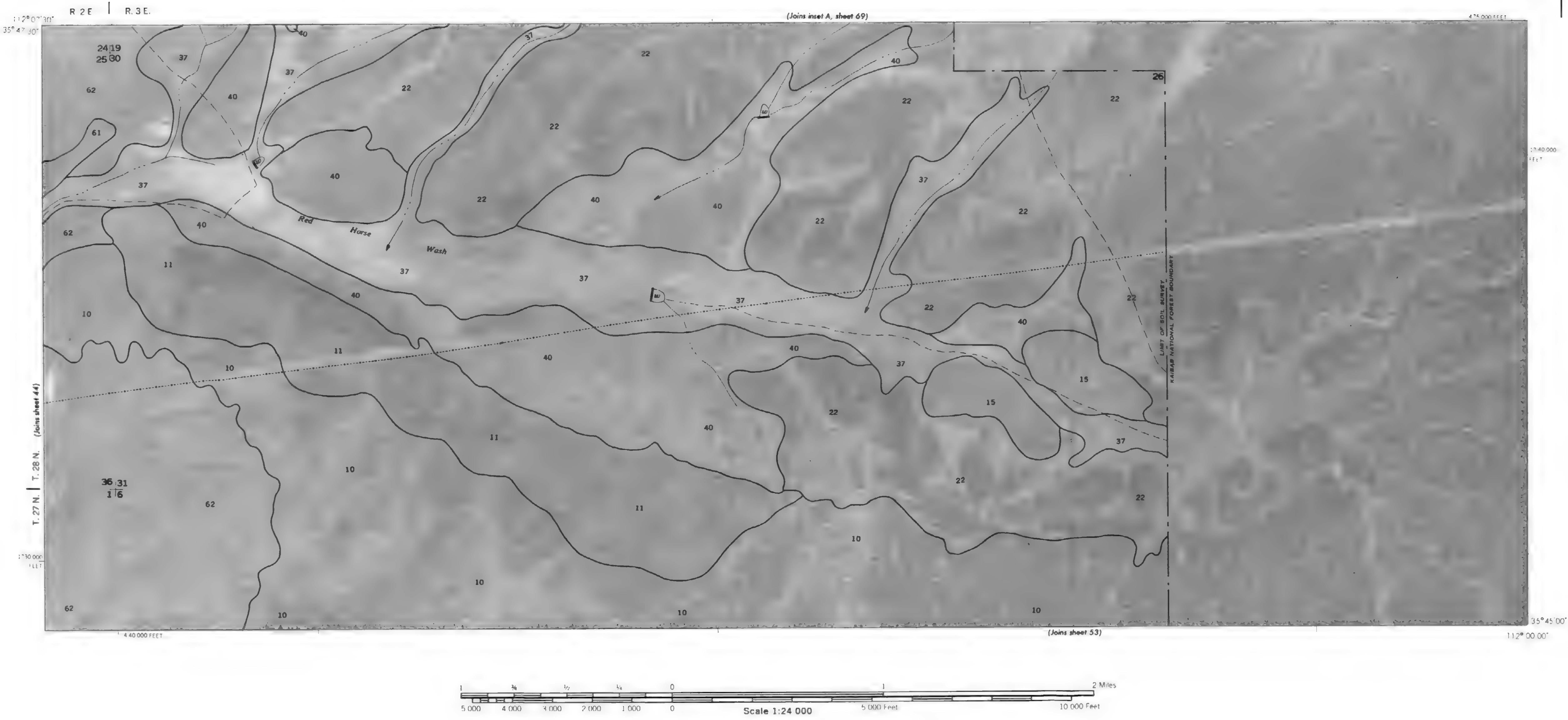
1 ¾ ½ ¼ 0 1 2 Miles
5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.
This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 45

This map was compiled on 1972 and 1973 U.S. Department of the Interior, Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies
5,000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned

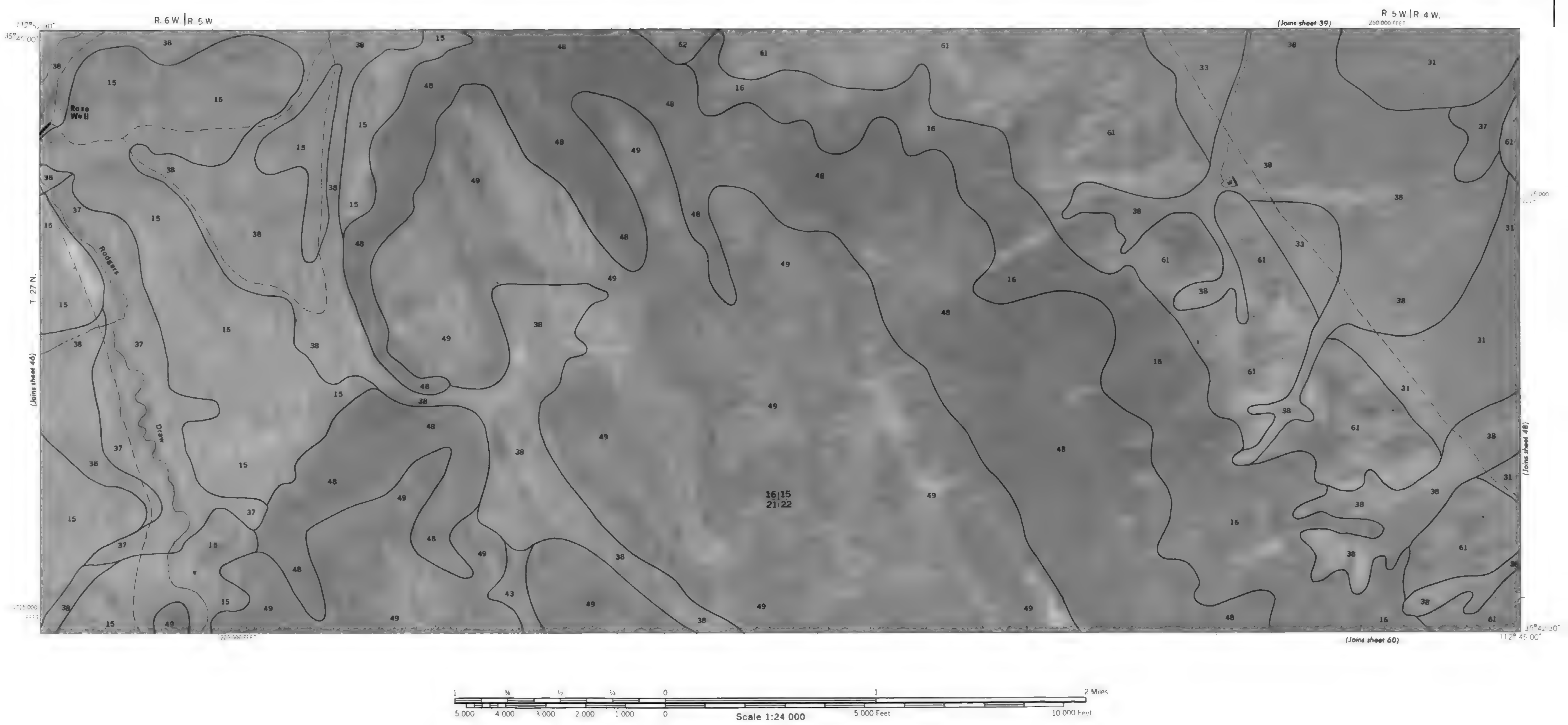


COCONINO COUNTY, ARIZONA, CENTRAL PART — SHEET NUMBER 46

5 000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotography by the U.S. Department of Agriculture Soil Conservation Service and cooperating agencies.

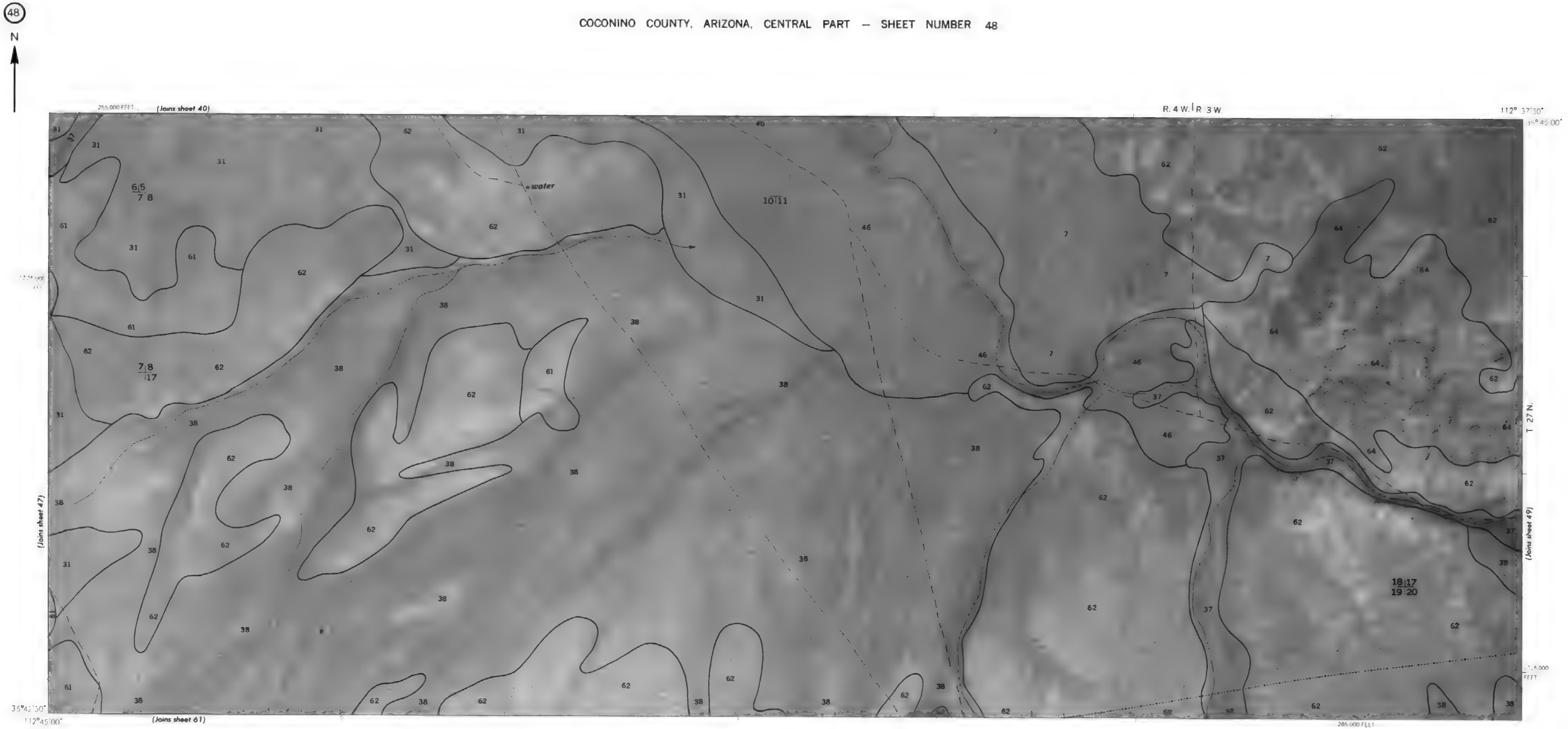
COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 46



COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 47

This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotographs by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

(48)



1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

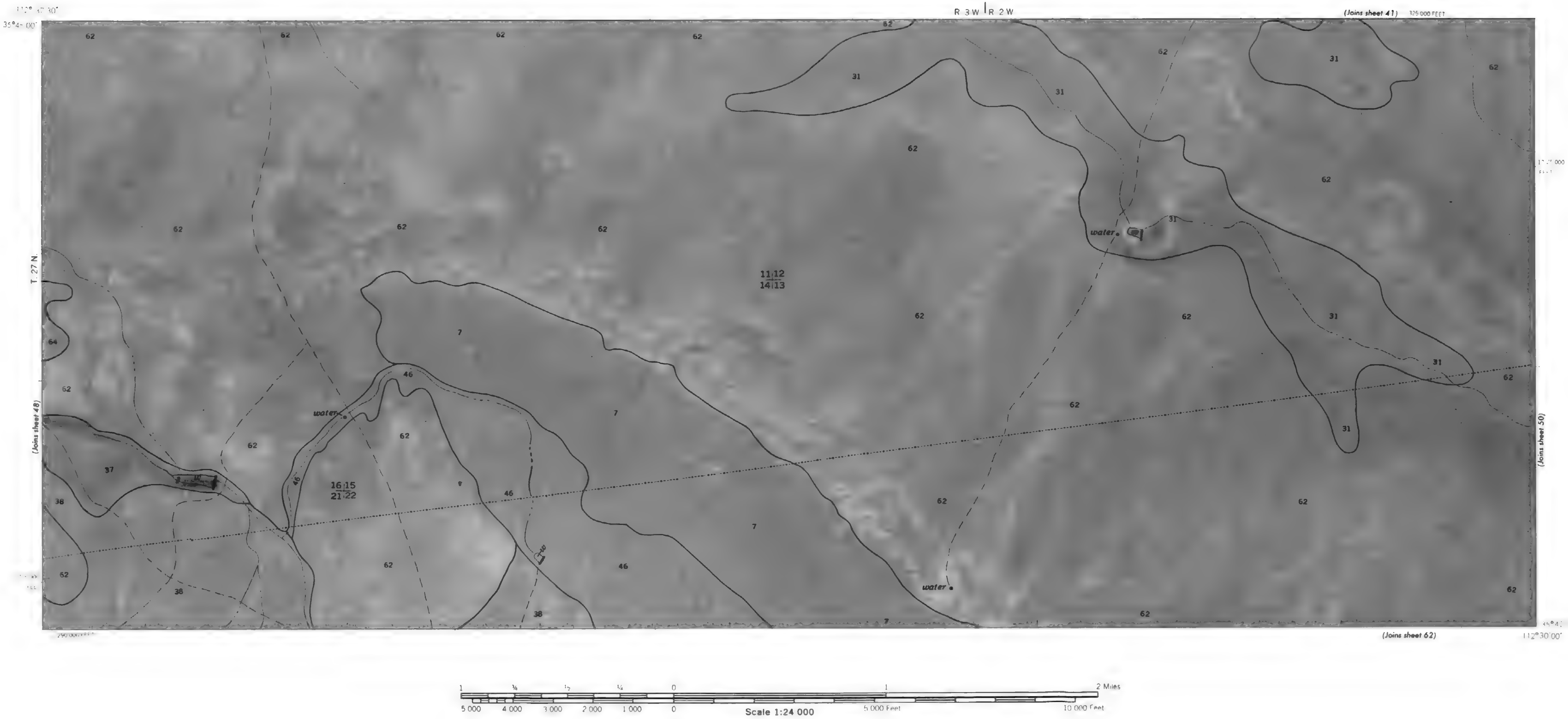
Scale 1:24 000

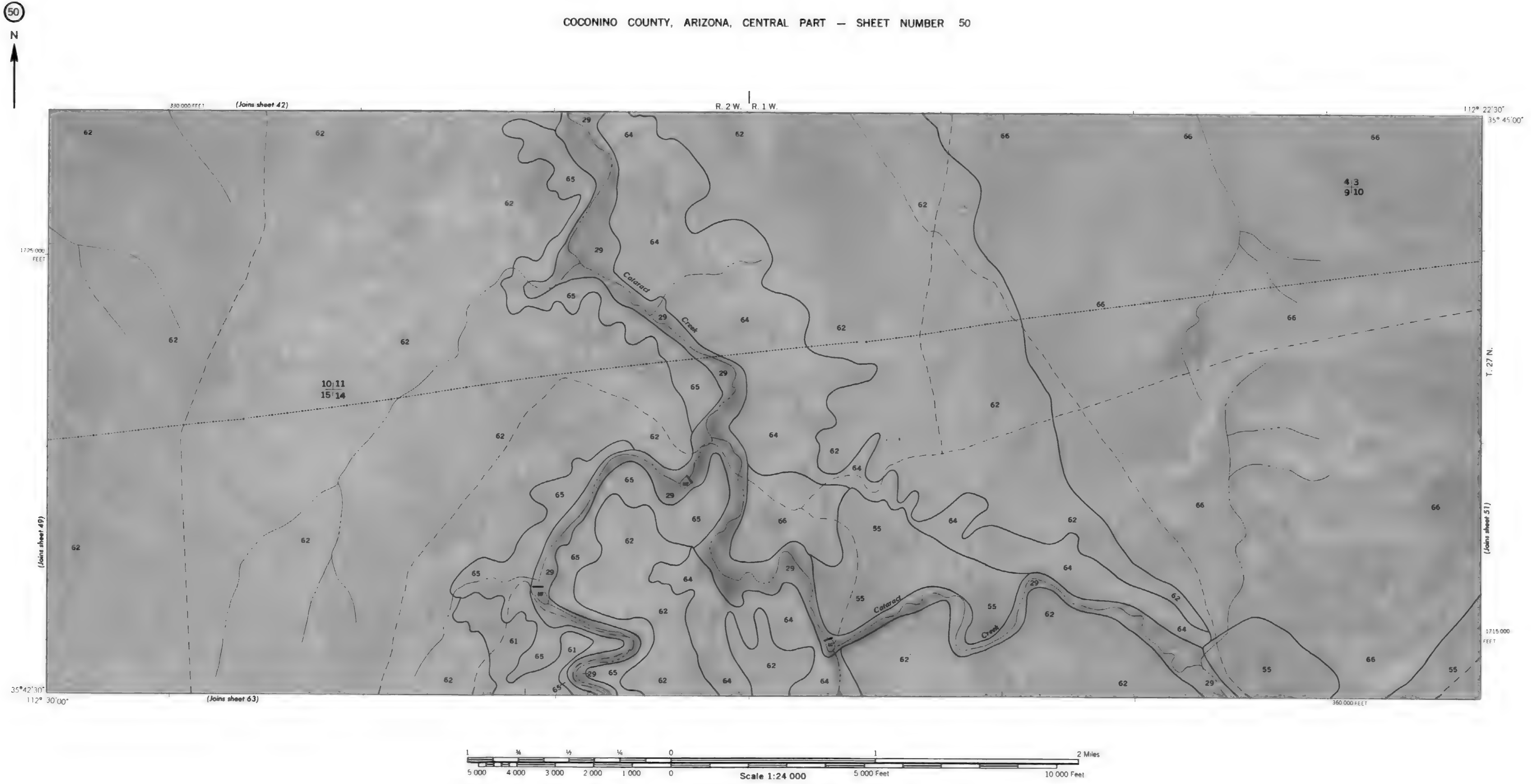
5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 49

This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. 5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.



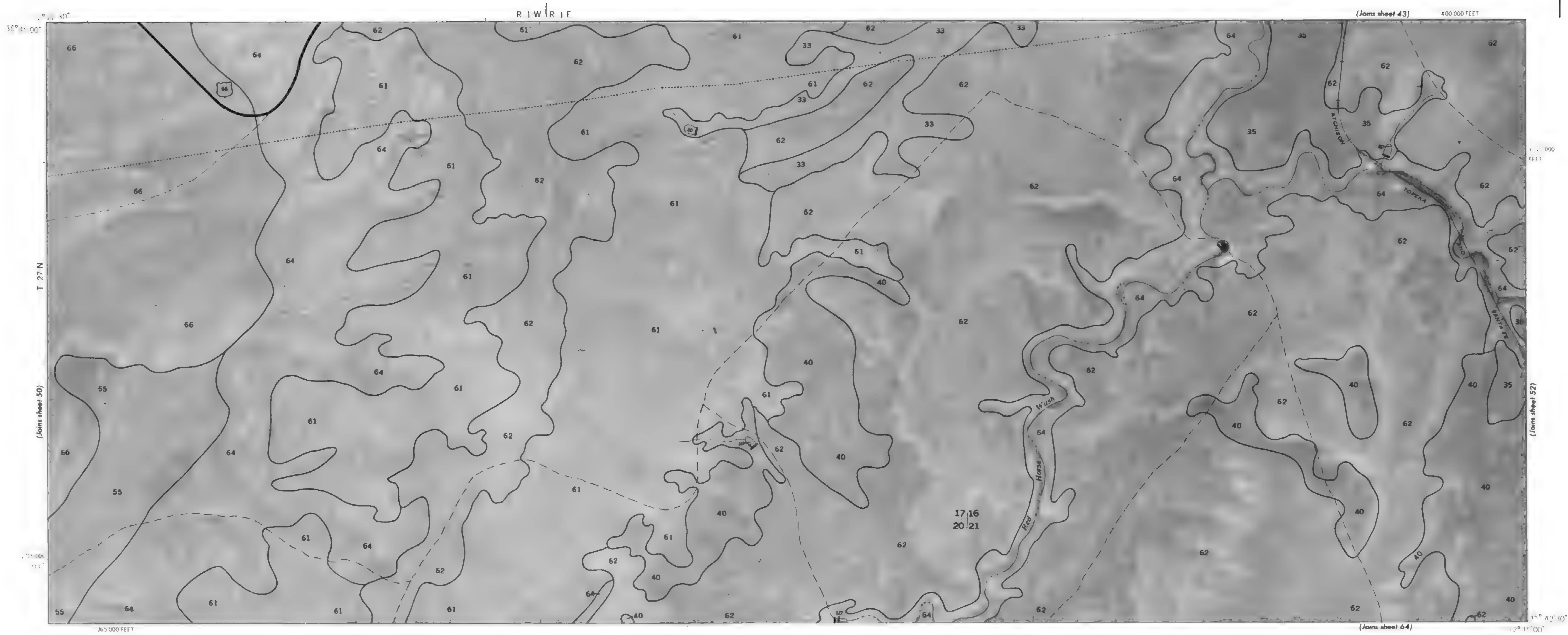


5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

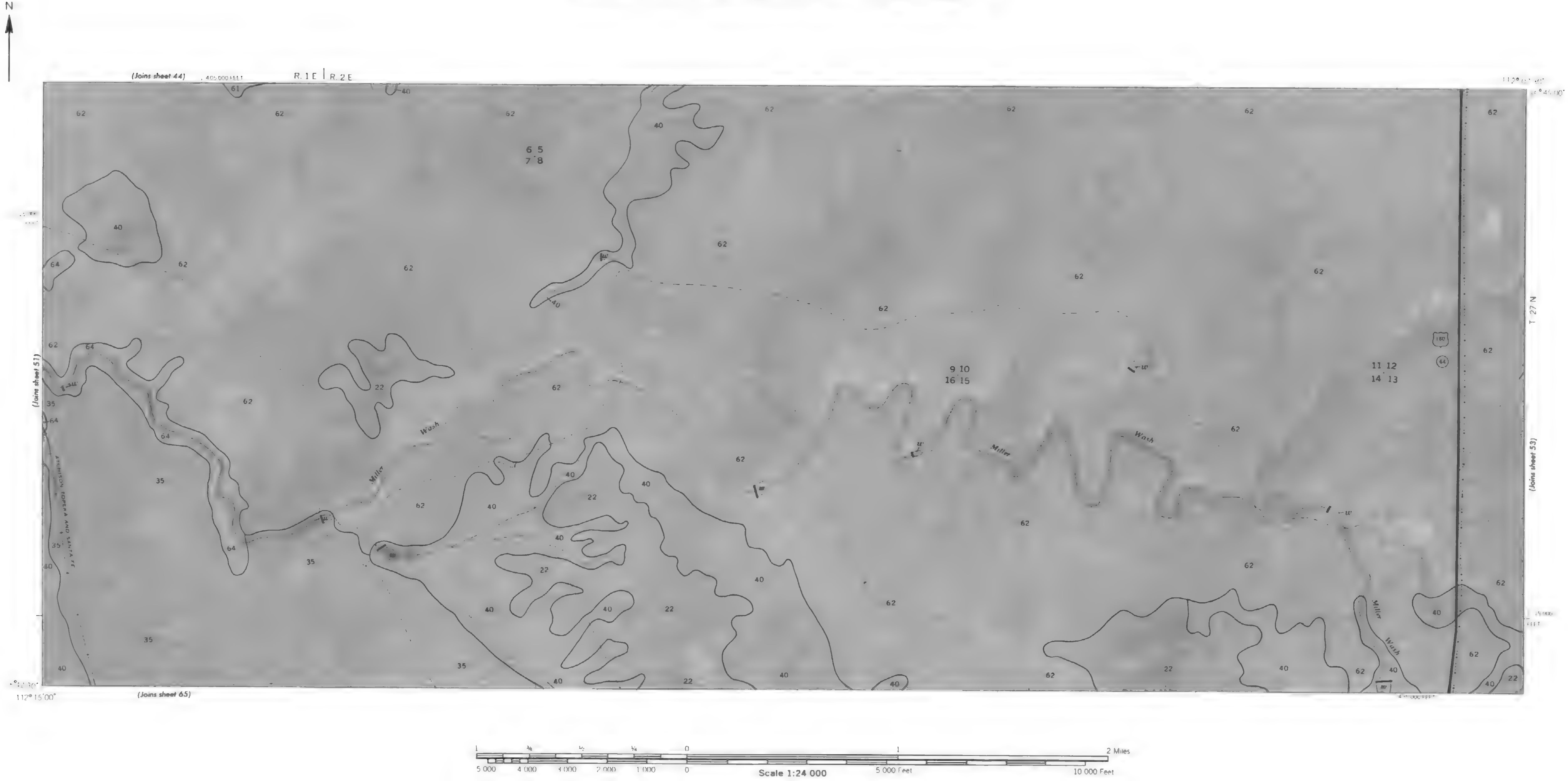
COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 50

This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.



Scale 1:24 000
1 ½ ¼ 0 1 2 Miles
5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

COCONINO COUNTY, ARIZONA, CENTRAL PART — SHEET NUMBER 52

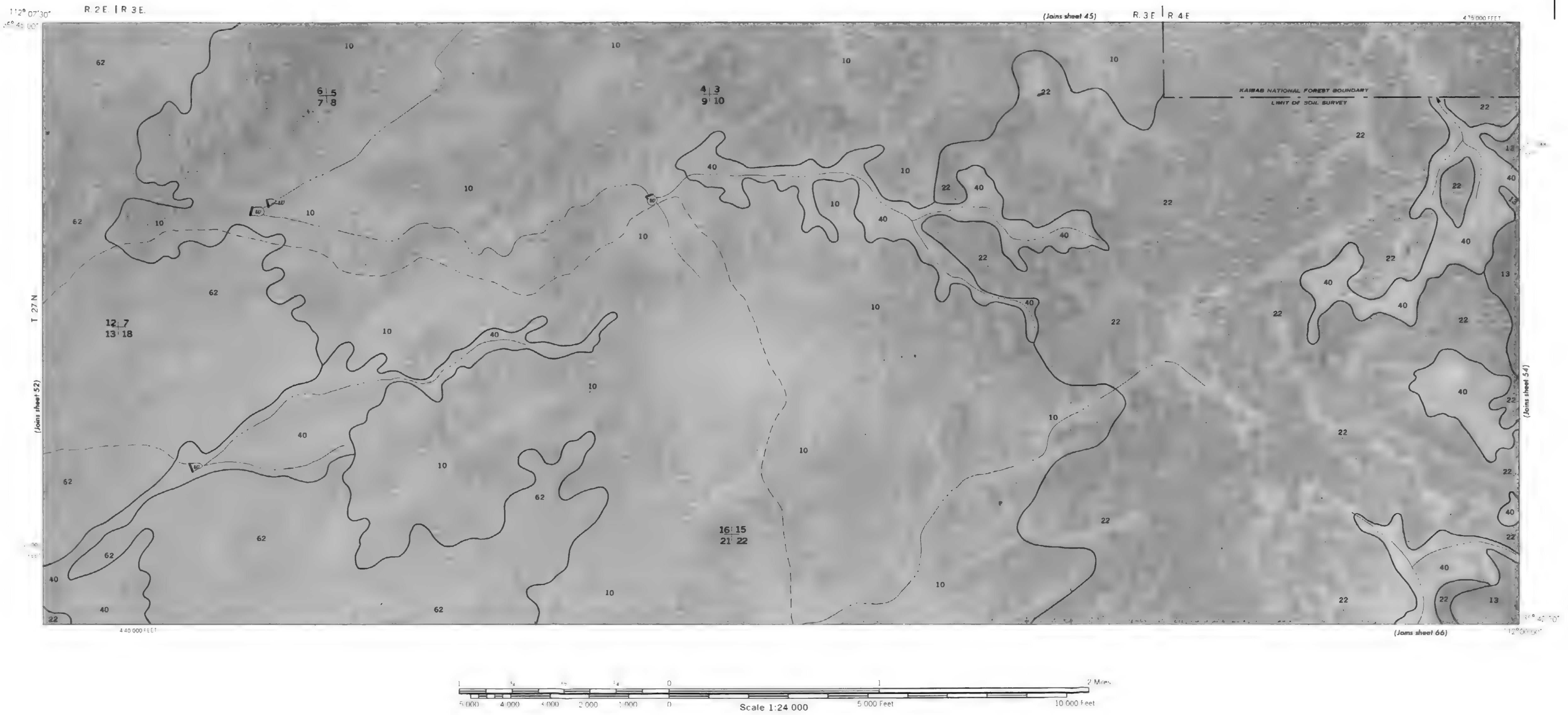


5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1972 and 1973 U.S. Department of The Interior Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

53

N



COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 53

This map was compiled on 1972 and 1973 U.S. Department of the Interior, Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000 foot grid ticks based on state coordinate system. Land division corners if shown are approximately positioned.

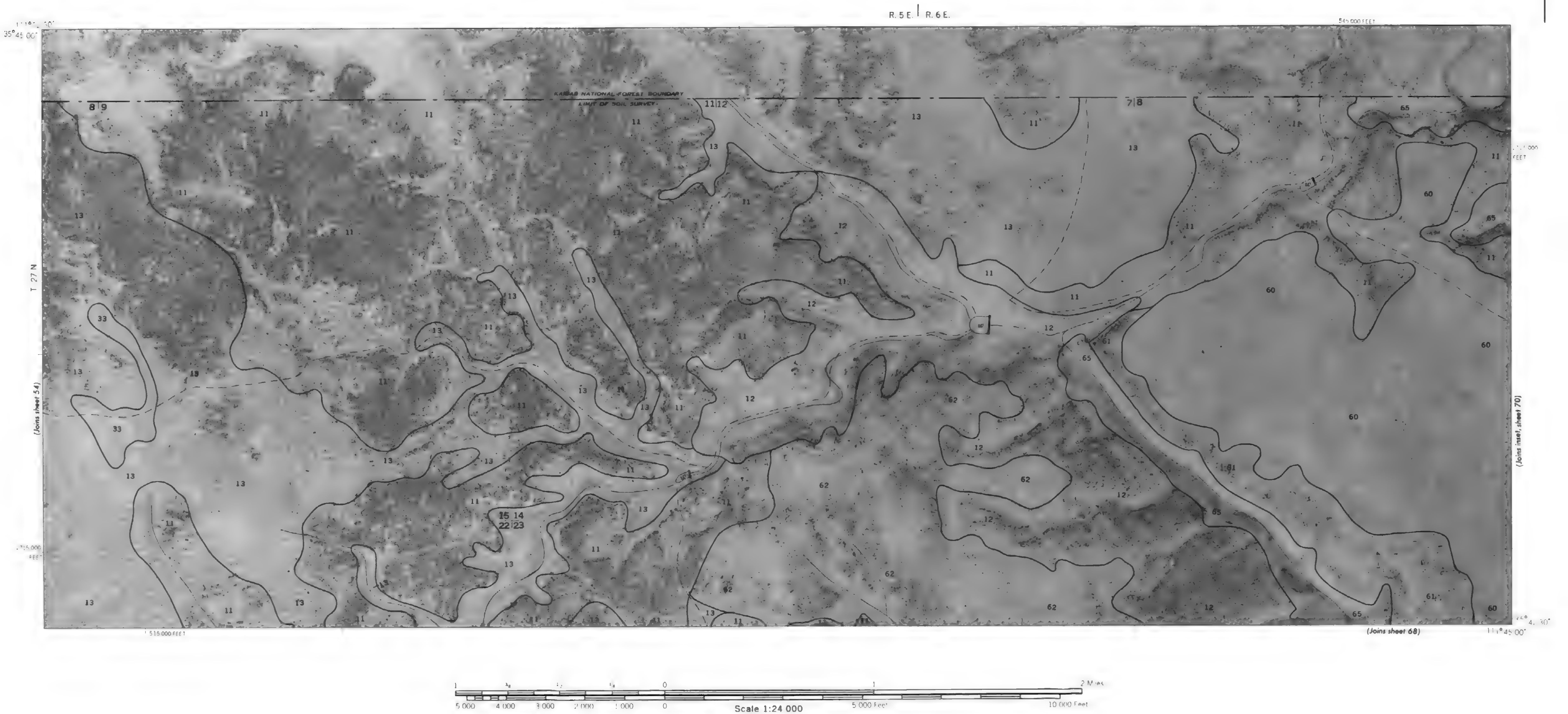
COCONINO COUNTY, ARIZONA, CENTRAL PART — SHEET NUMBER 54

5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

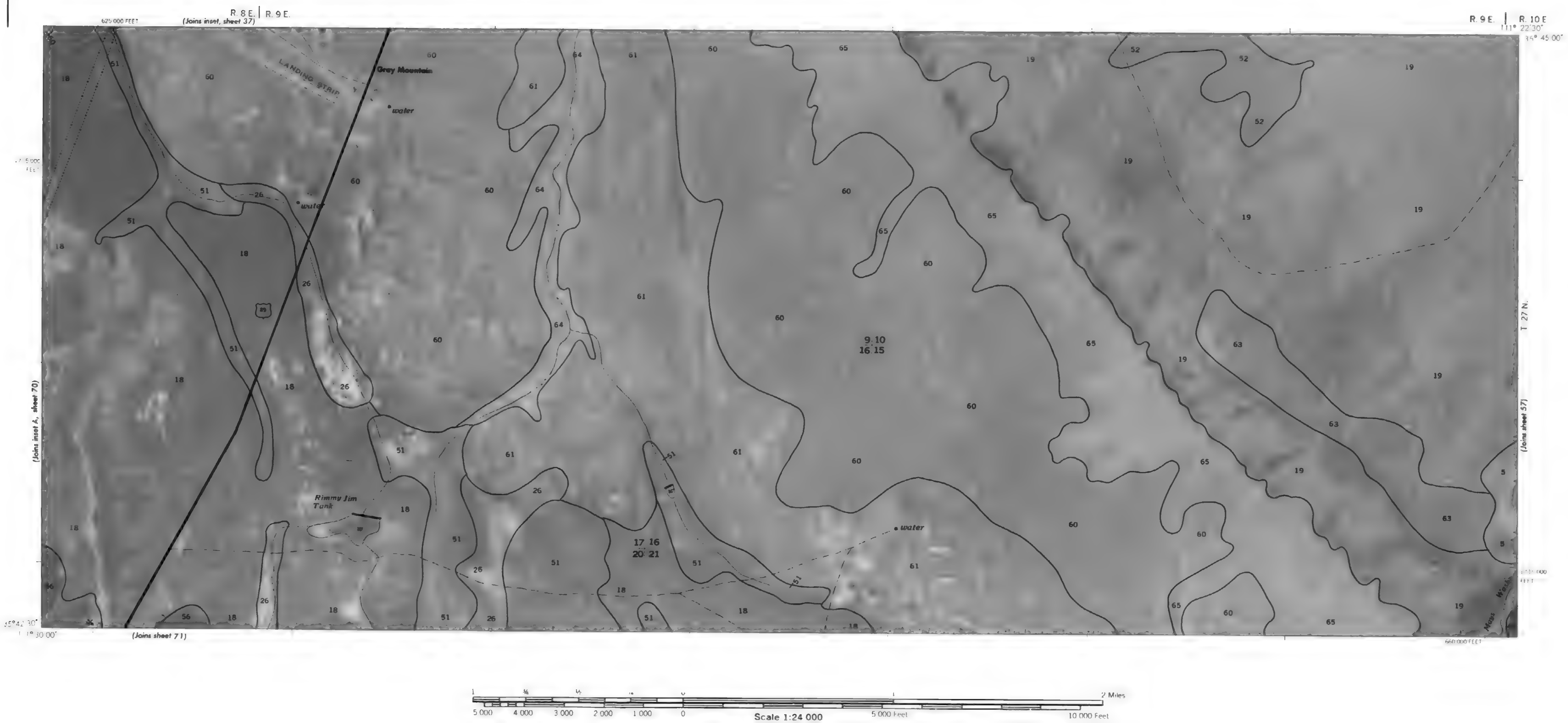
This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 54

This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotographs by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.



COCONINO COUNTY, ARIZONA, CENTRAL PART — SHEET NUMBER 56



5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

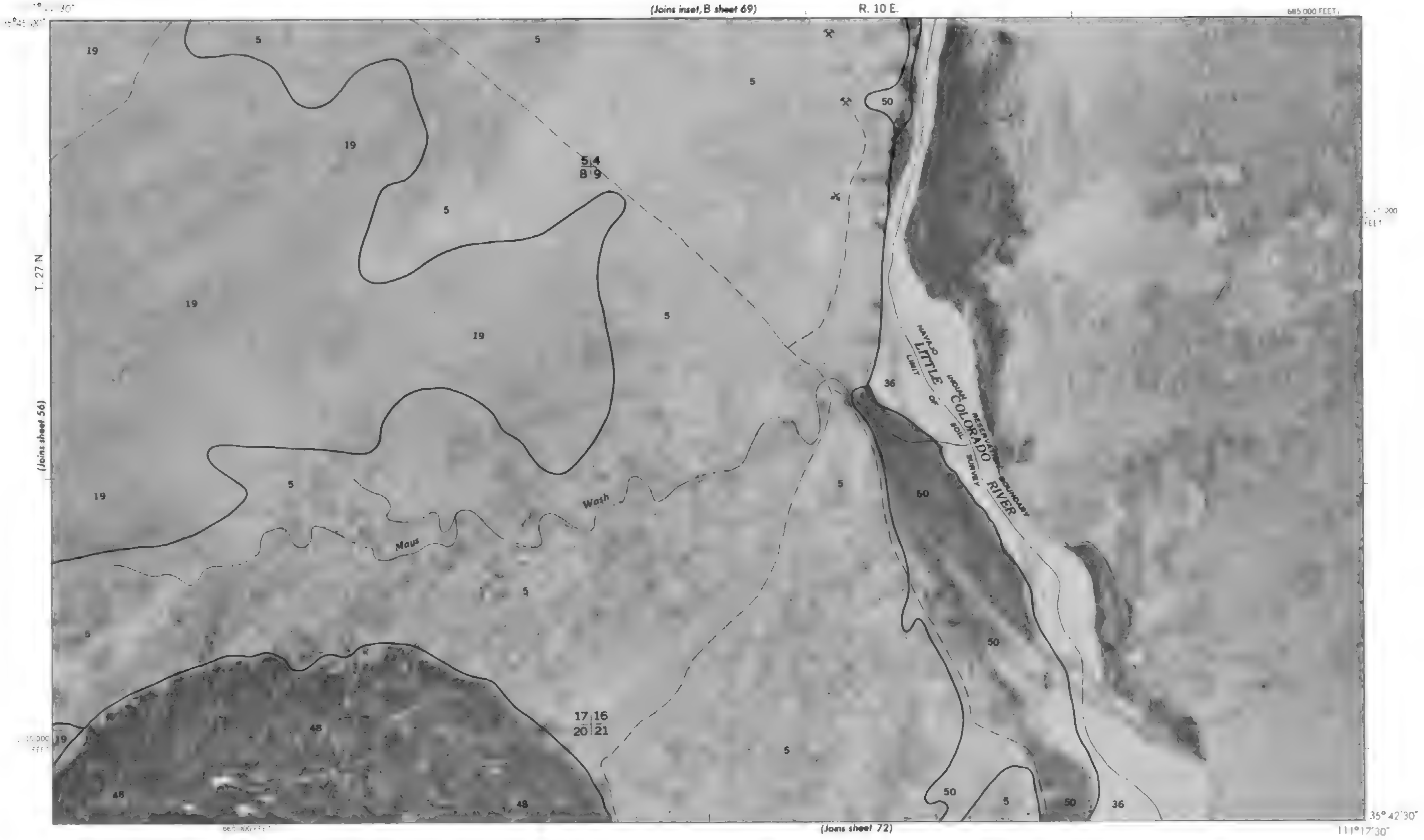
COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 56

57

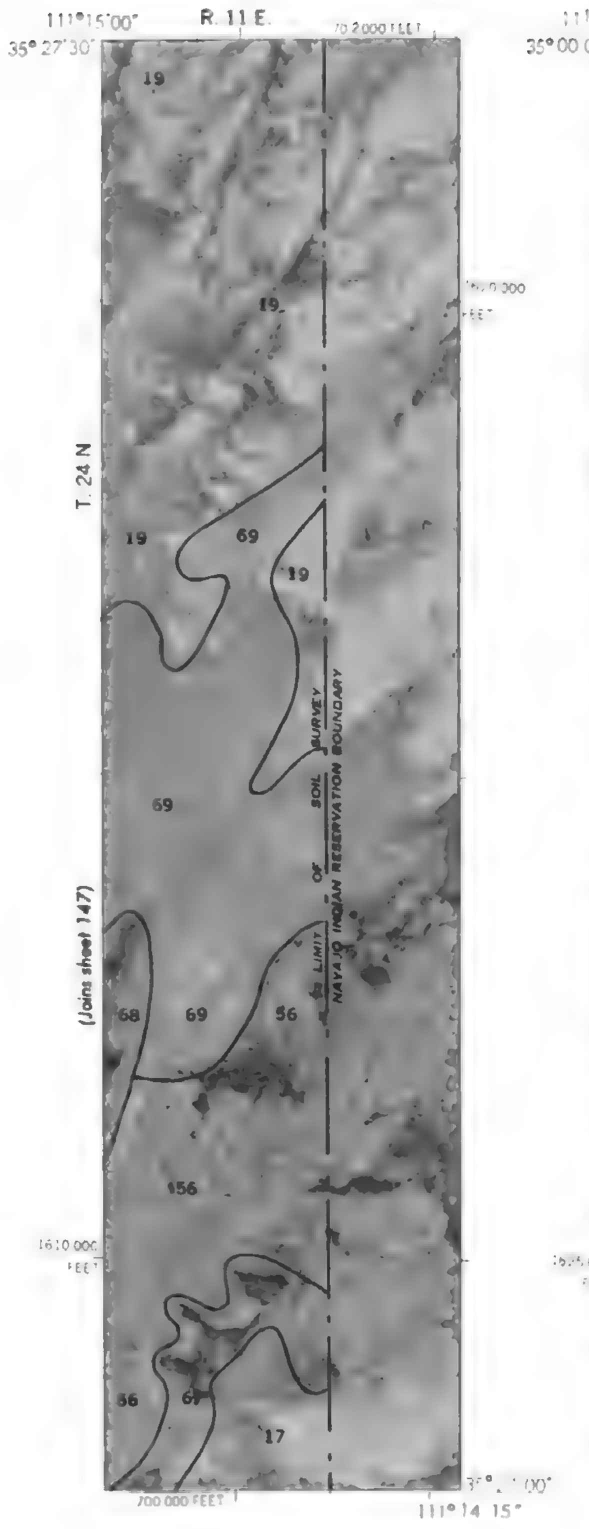
N

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 57

This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotography by the U.S. Department of Agriculture Soil Conservation Service and cooperating agencies.
5 000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

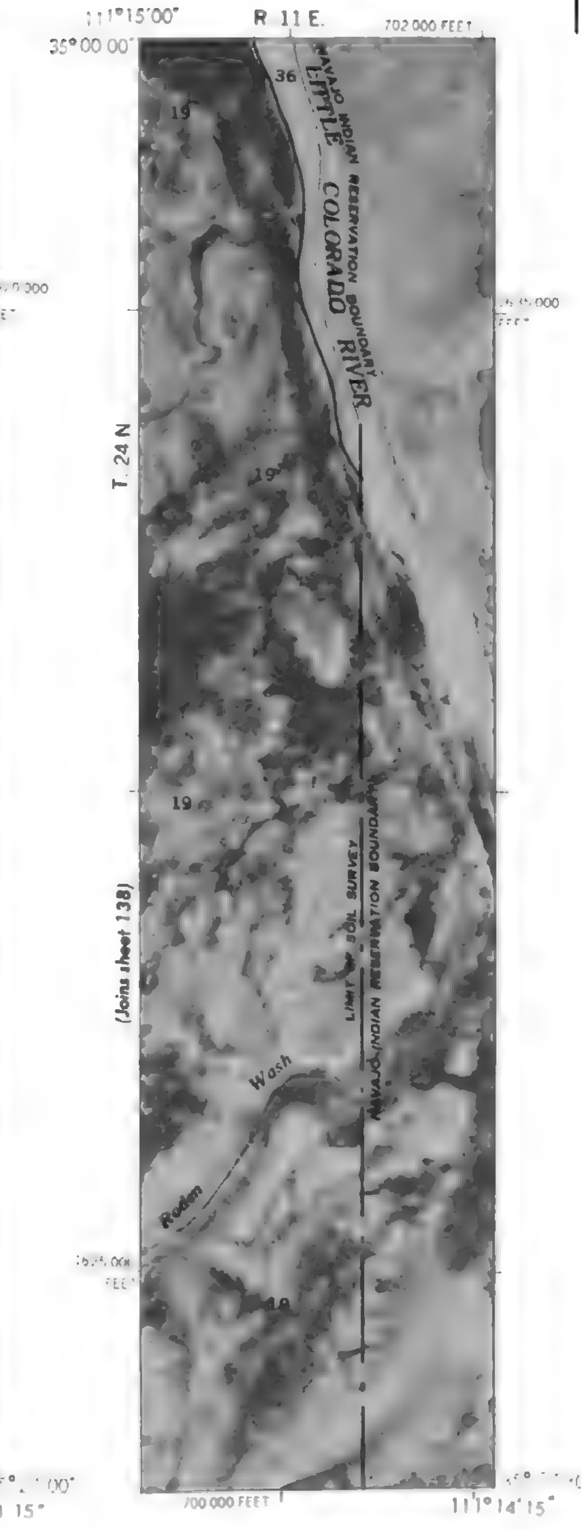


INSET A



2000 AND 5000-FOOT GRID TICKS

INSET B

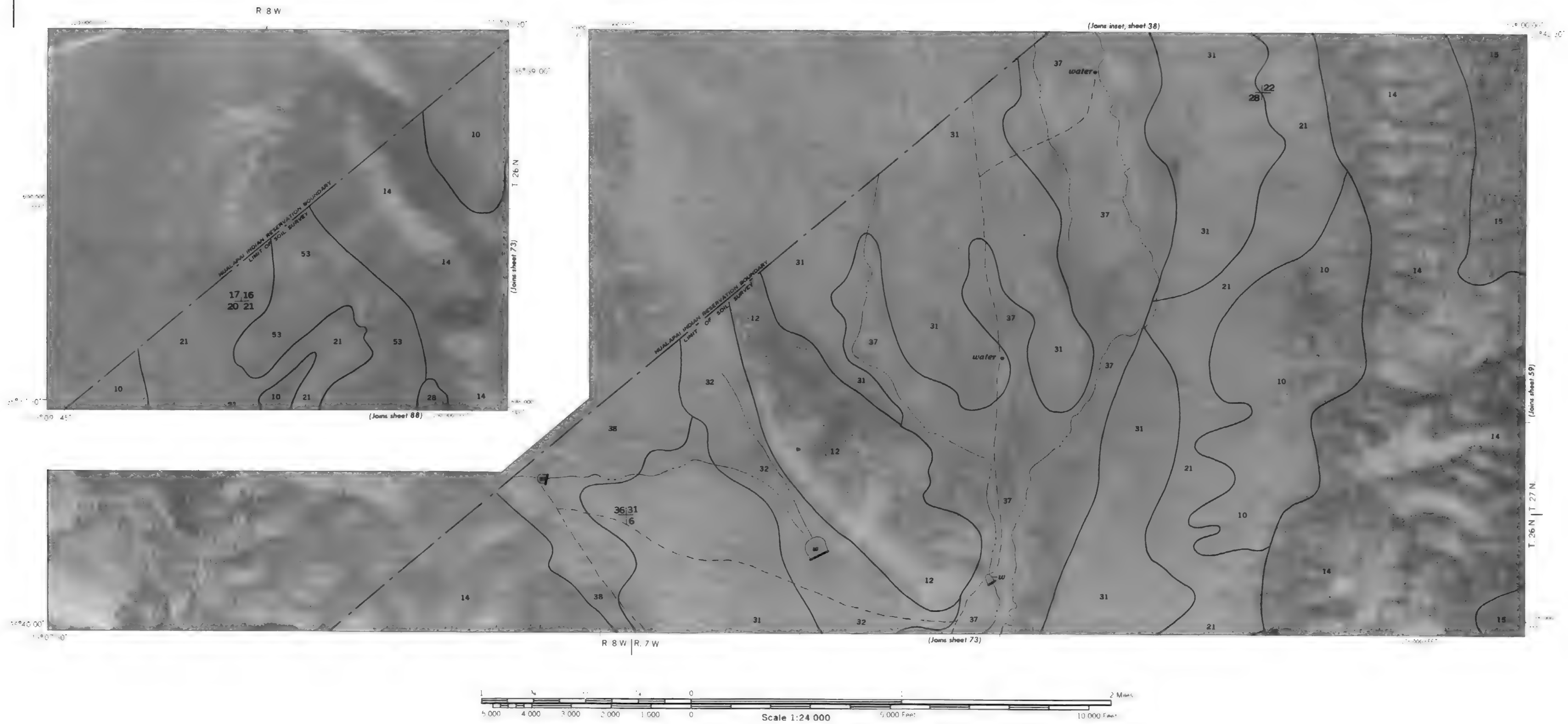


2000 AND 5000-FOOT GRID TICKS

1 ¾ ½ ¼ 0 1 2 Miles
5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

COCONINO COUNTY, ARIZONA, CENTRAL PART — SHEET NUMBER 58

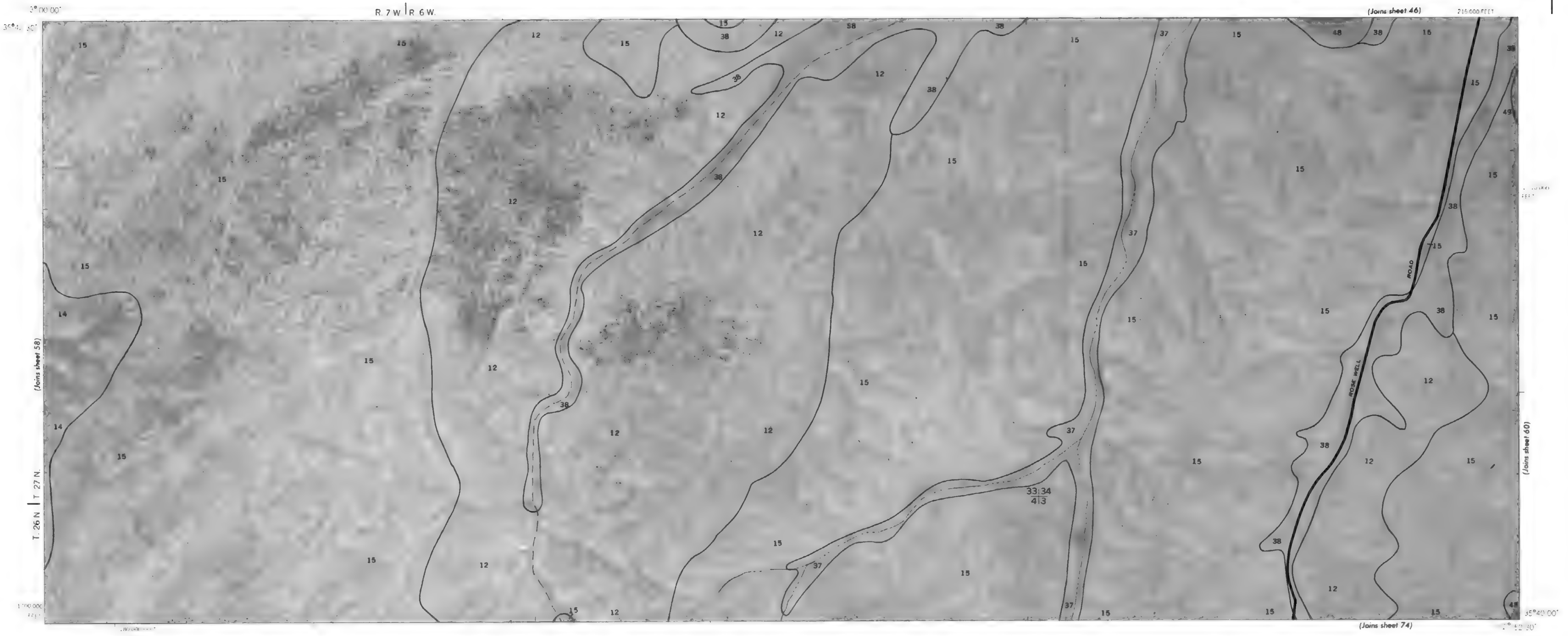


5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 58

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 59

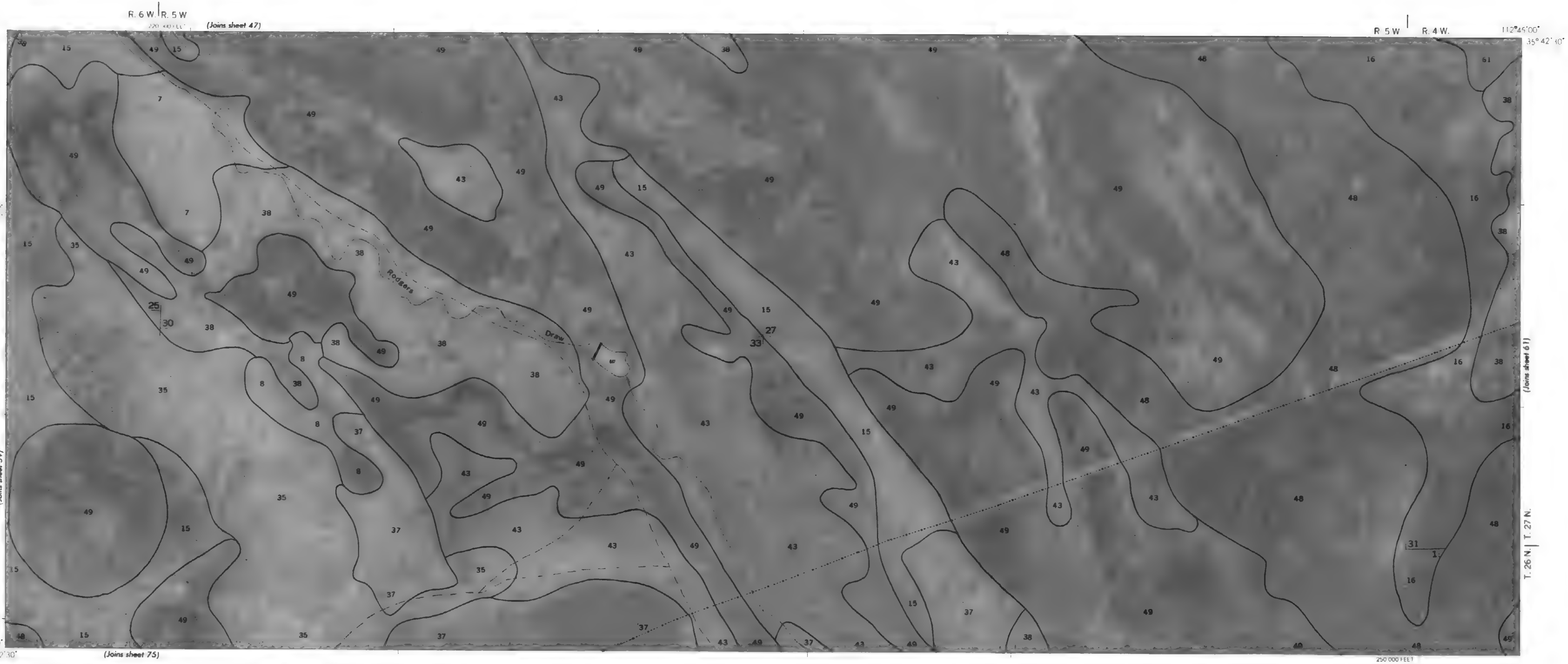


Scale 1:24 000

1 ½ 0 1 2 Miles
5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

N

COCONINO COUNTY, ARIZONA, CENTRAL PART — SHEET NUMBER 60



1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

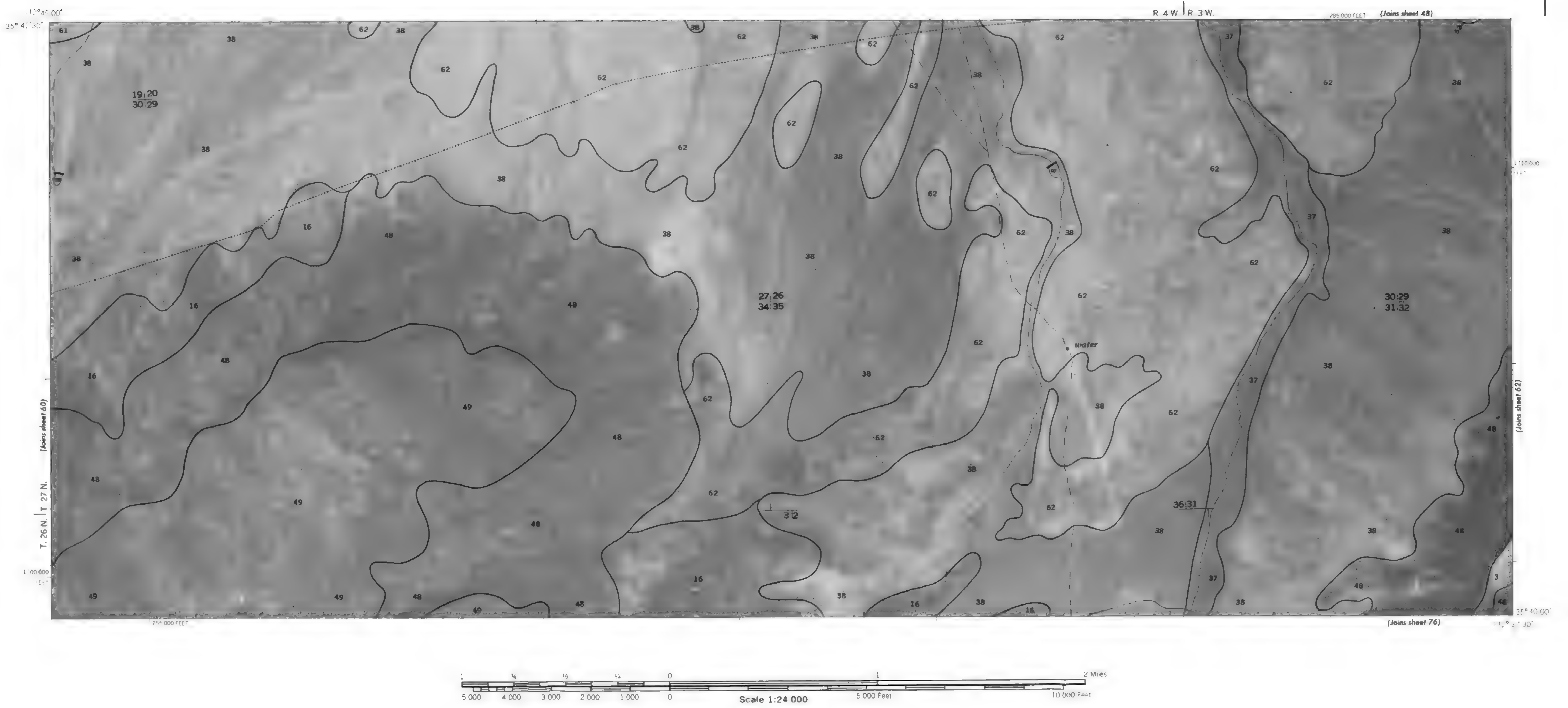
Scale 1:24 000

5 000 foot grid ticks based on state coordinate system. Land division corners if shown are approximately positioned

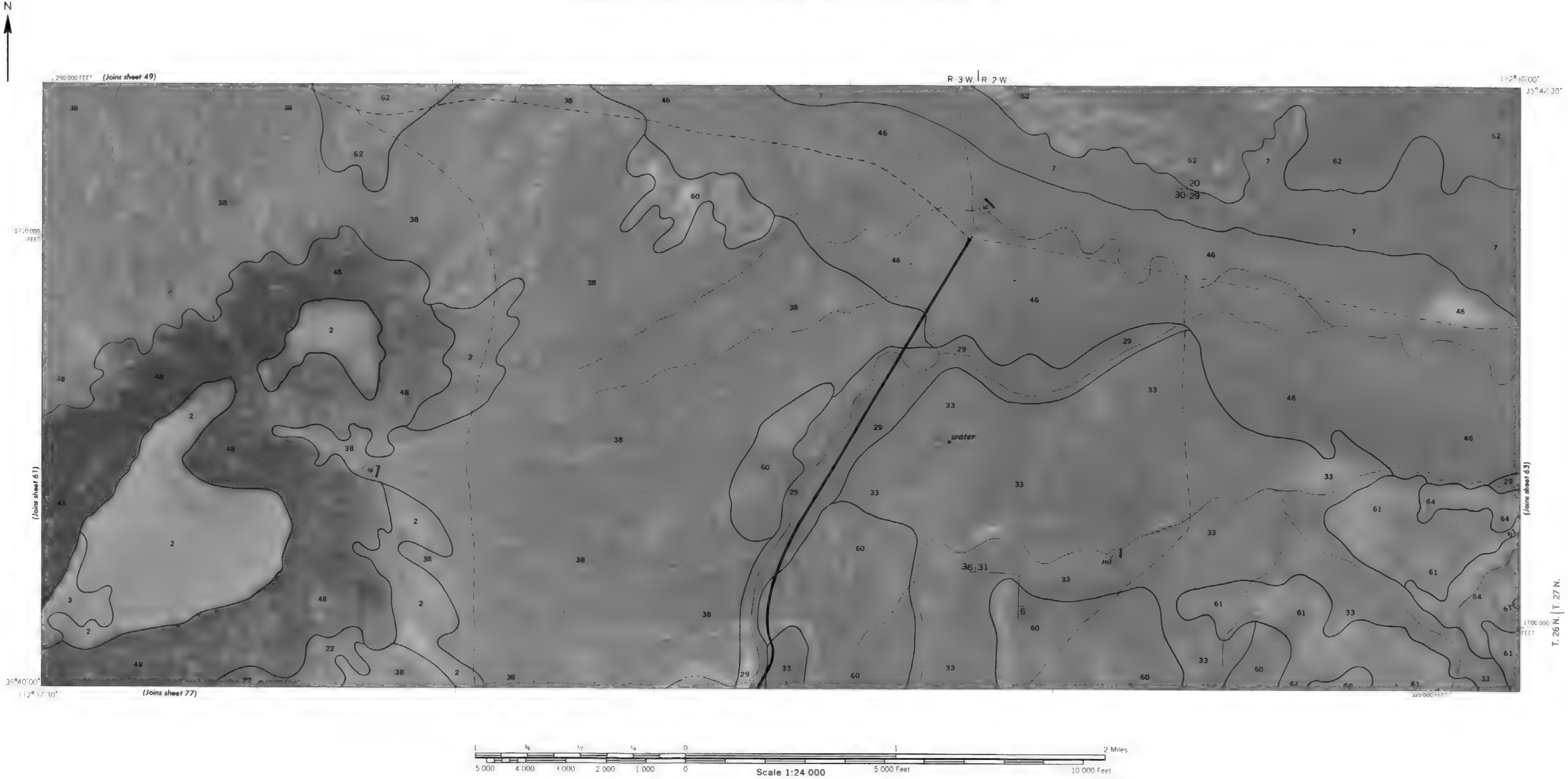
This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotography by the U.S. Department of Agriculture Soil Conservation Service and cooperating agencies

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 61

This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotography by the U.S. Department of Agriculture Soil Conservation Service and cooperating agencies.
5,000 foot grid ticks based on state coordinate system. Land division corners if shown are approximately positioned.



COCONINO COUNTY, ARIZONA, CENTRAL PART — SHEET NUMBER 62



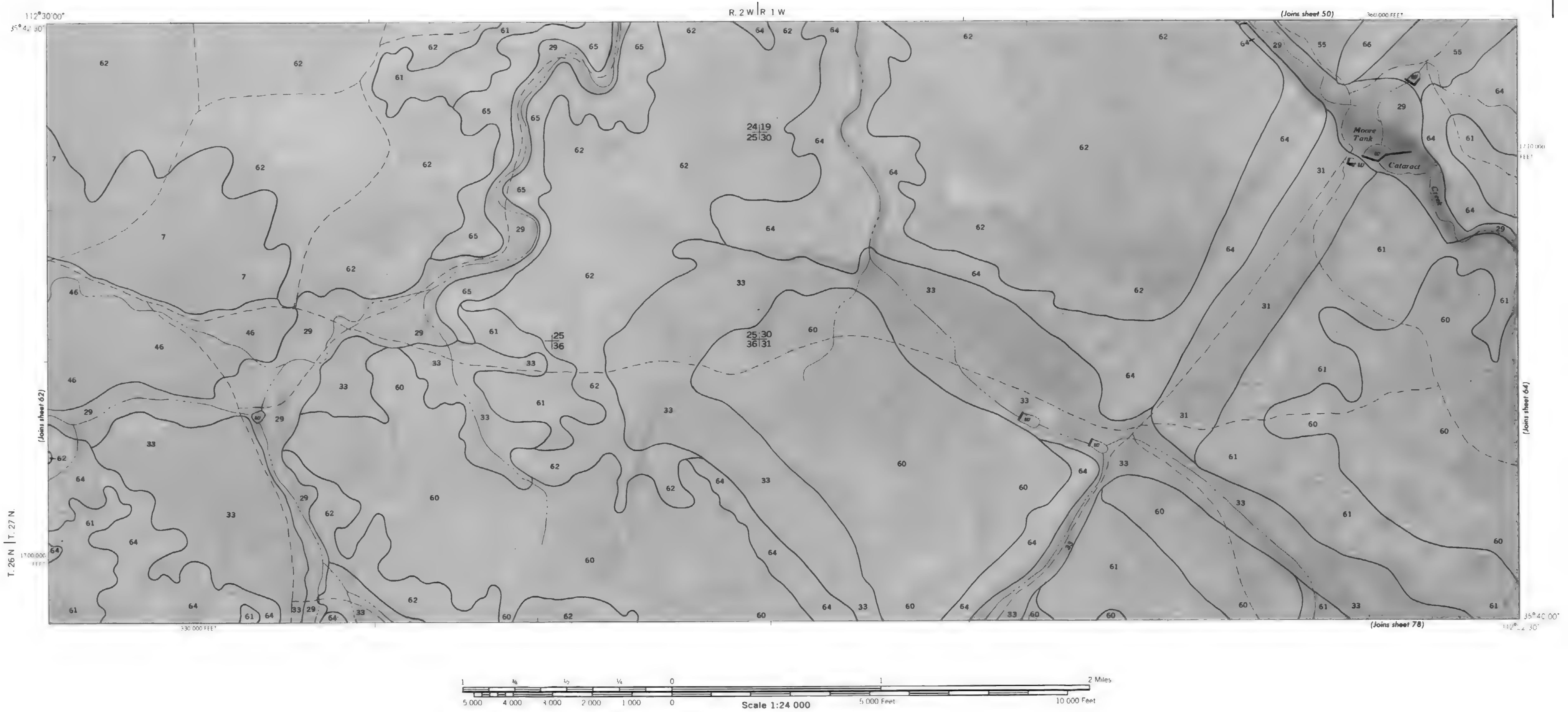
COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 62

This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

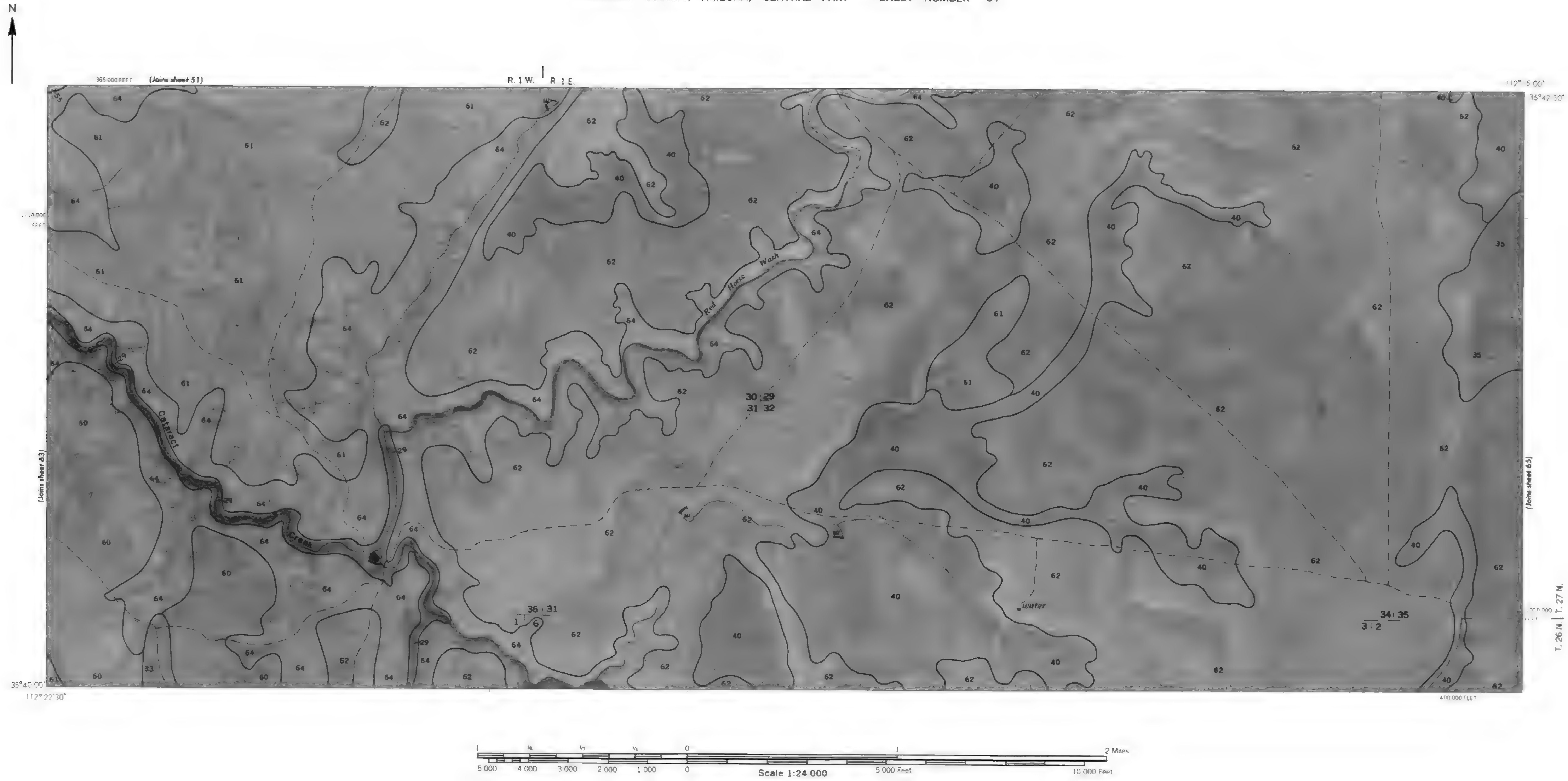
5 000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

COCONINO COUNTY, ARIZONA, CENTRAL PART — SHEET NUMBER 63

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 63



COCONINO COUNTY, ARIZONA, CENTRAL PART — SHEET NUMBER 64



5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

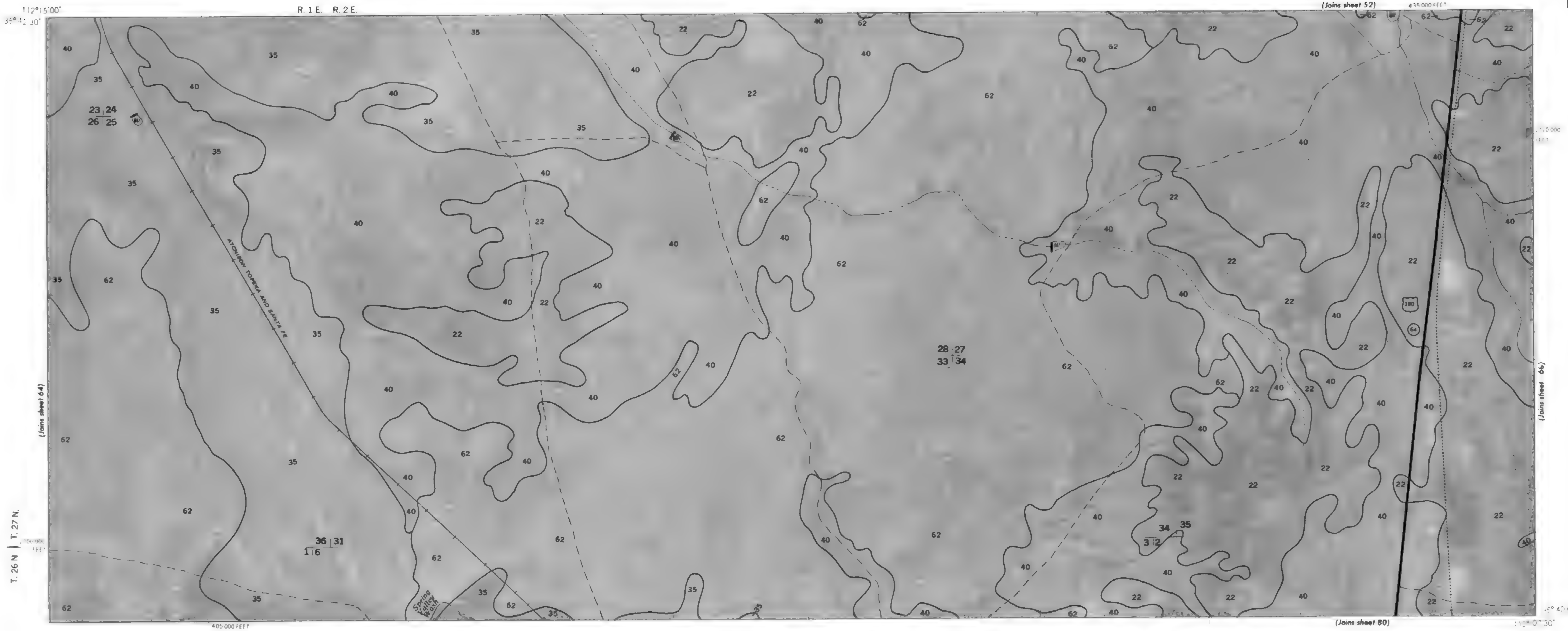
COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 64

65

N

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 65

This map was compiled on 1972 and 1973 U.S. Department of the Interior, Geological Survey orthophotographs by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. 5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

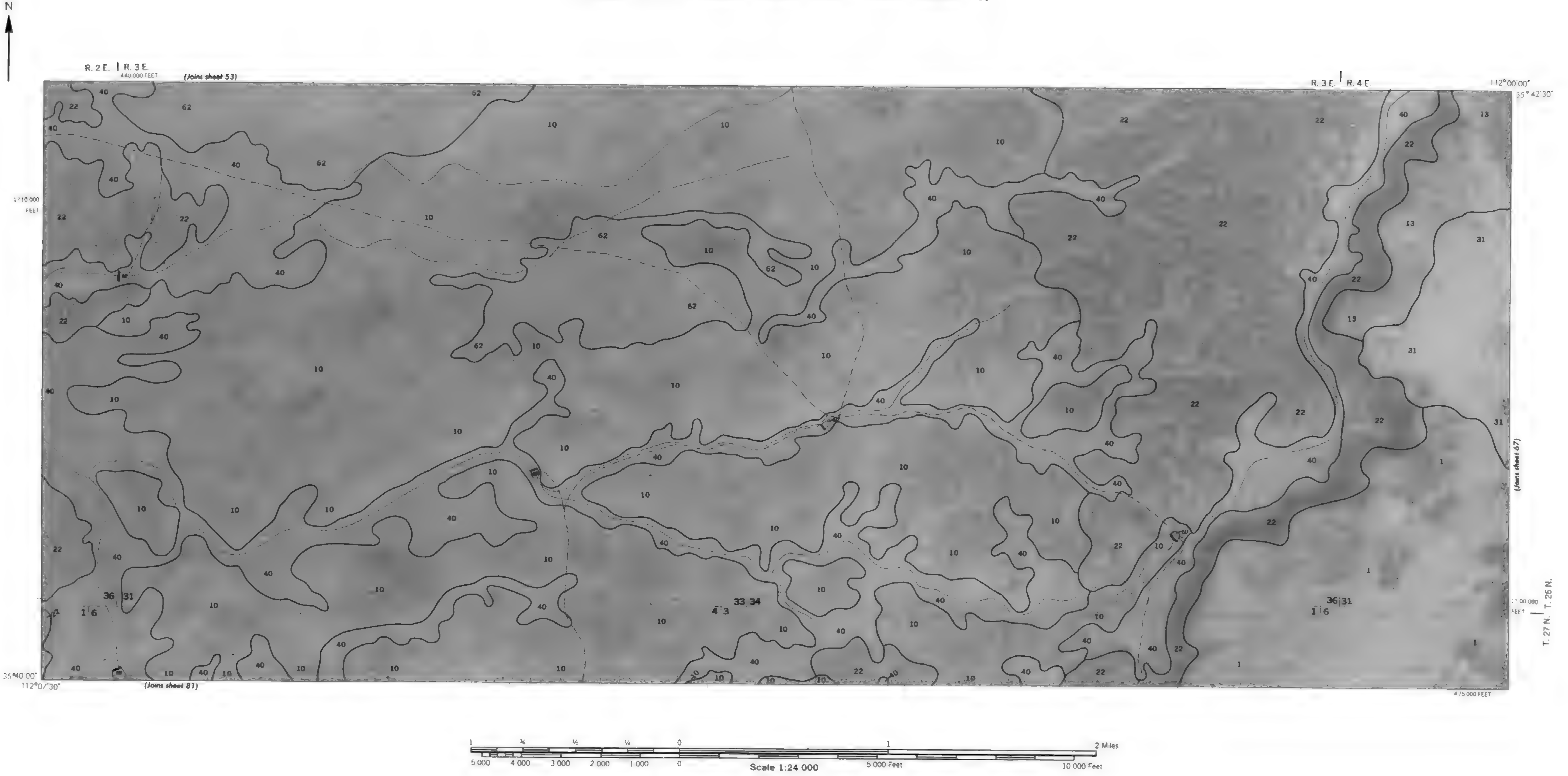


1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

COCONINO COUNTY, ARIZONA, CENTRAL PART — SHEET NUMBER 66



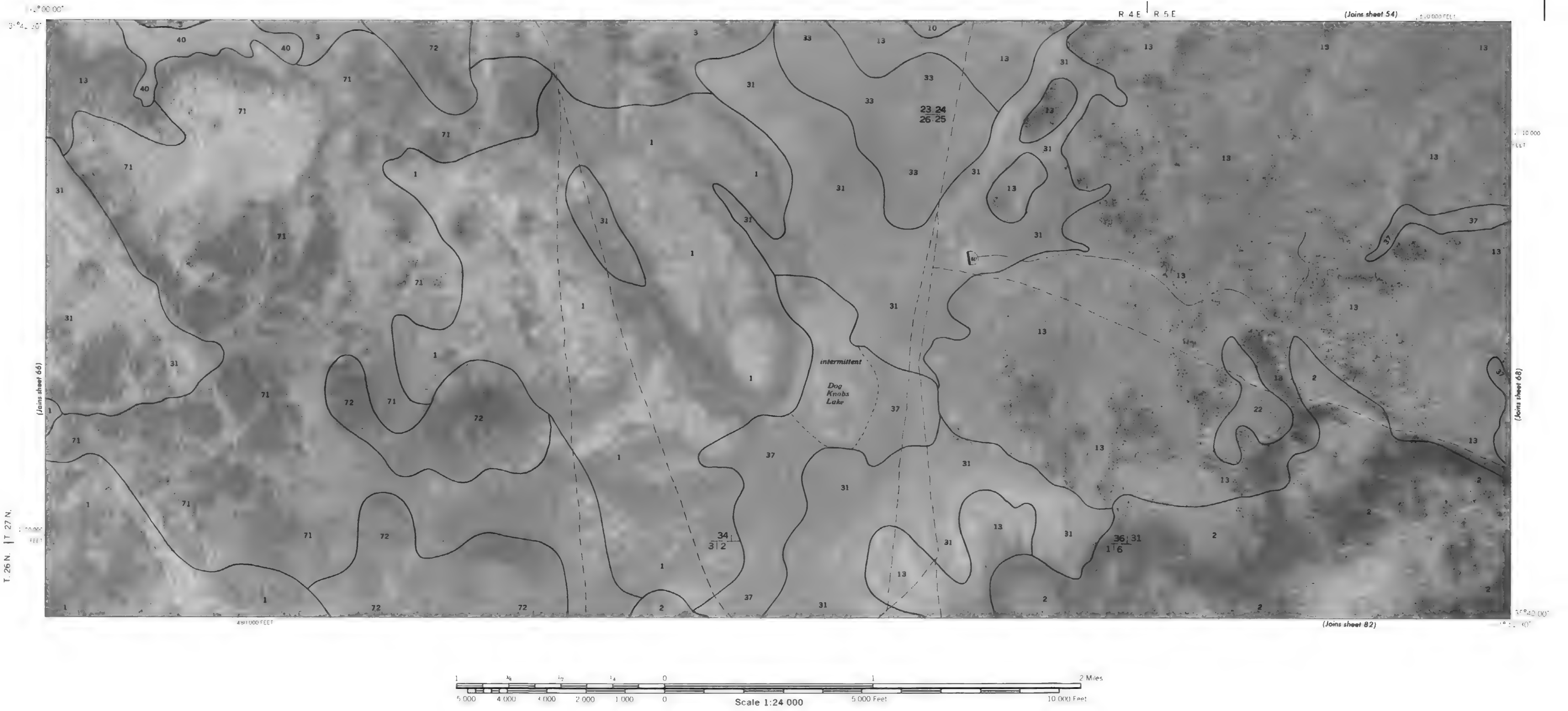
5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned

This map was compiled on 1972 and 1973 U.S. Department of The Interior, Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies

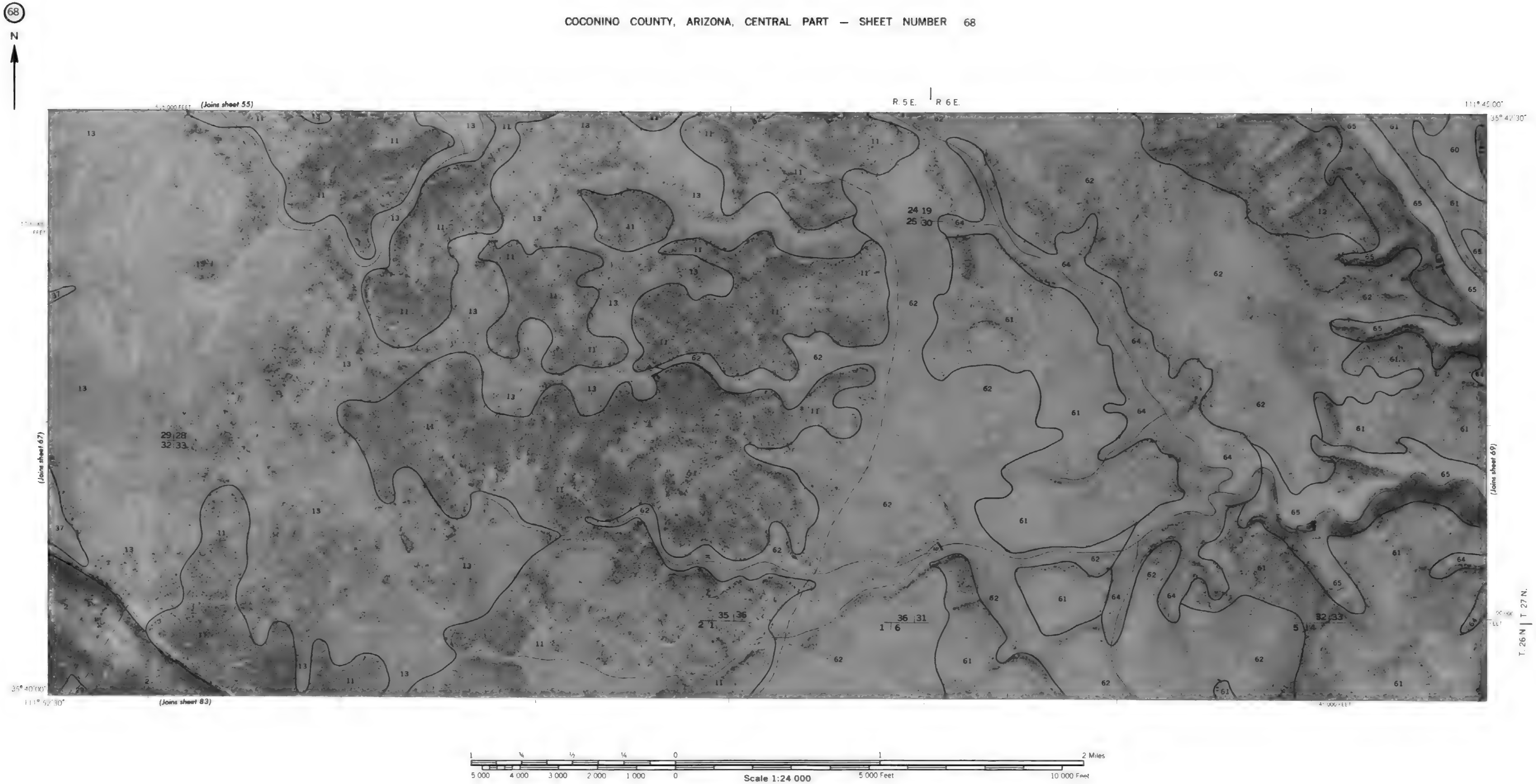
COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 66

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 67

This map was compiled on 1972 and 1973 U.S. Department of the Interior, Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.



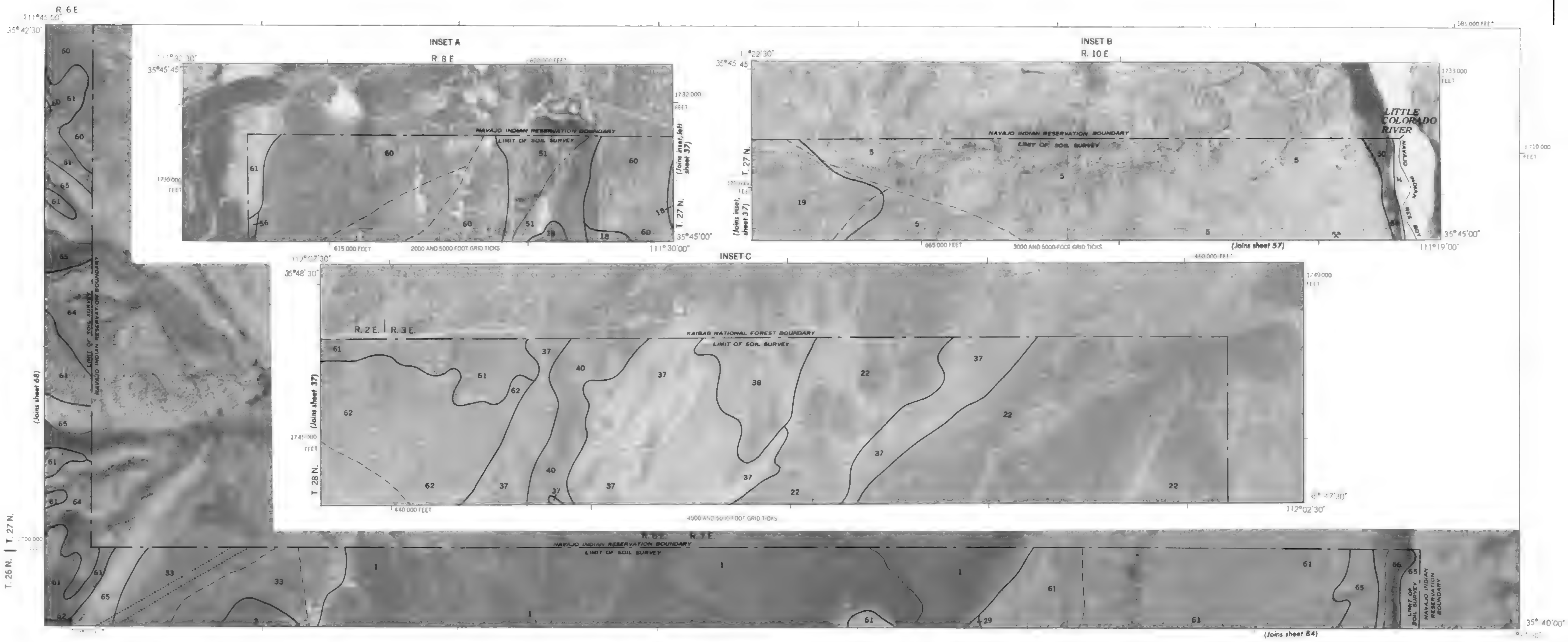
COCONINO COUNTY, ARIZONA, CENTRAL PART — SHEET NUMBER 68



5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotography by the U.S. Department of Agriculture Soil Conservation Service and cooperating agencies.

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 68



1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

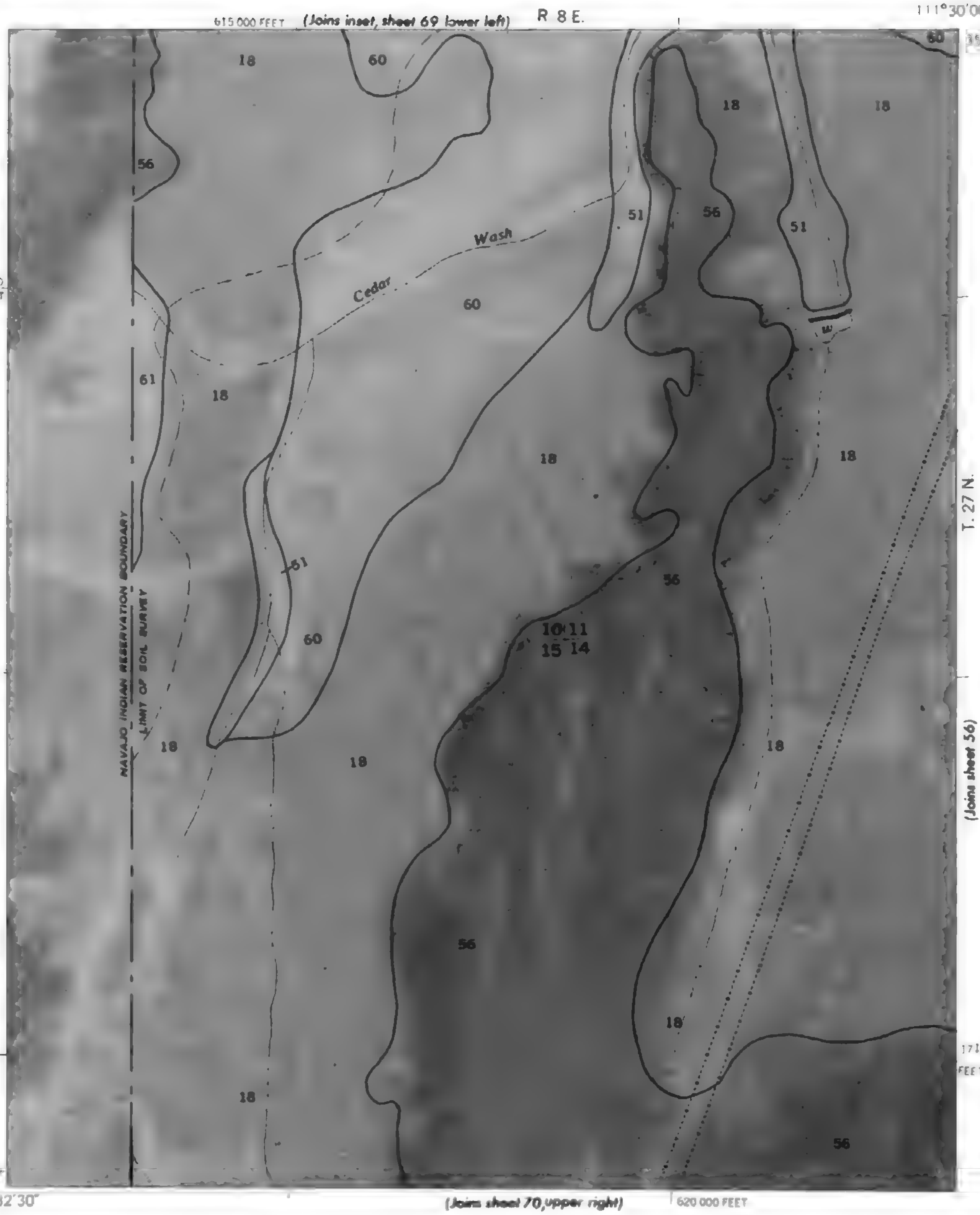
COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 69

This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotographs by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

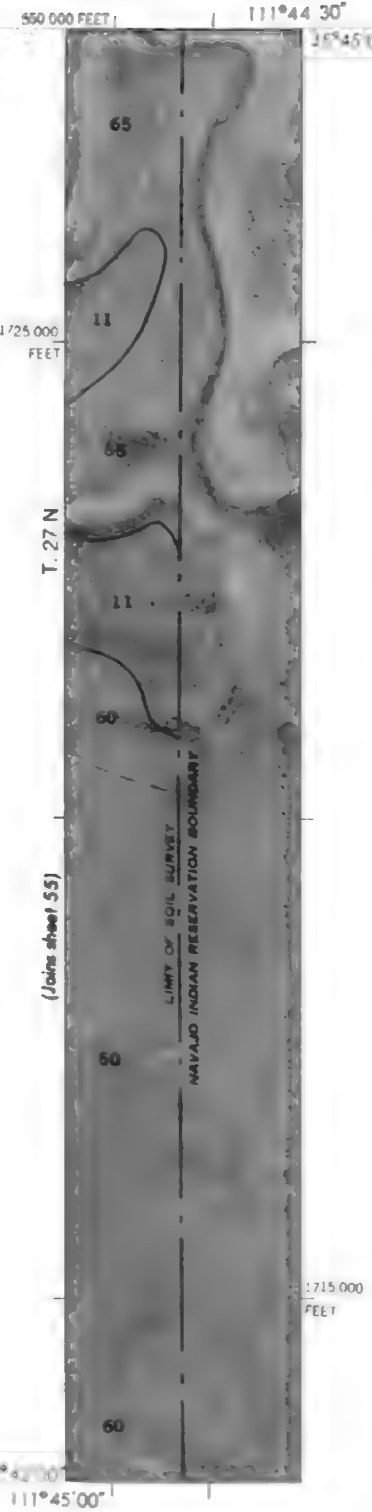
N

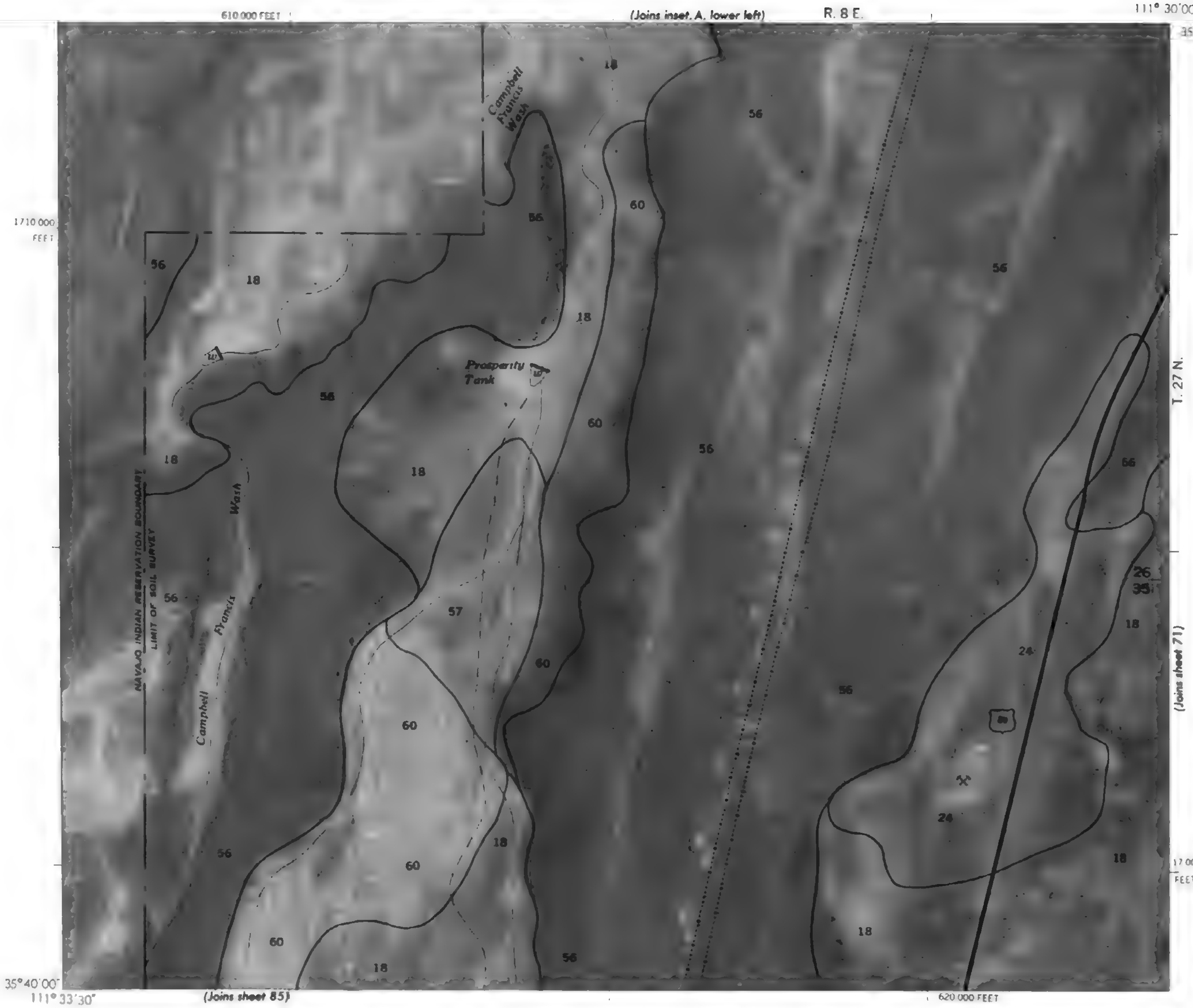
COCONINO COUNTY, ARIZONA, CENTRAL PART — SHEET NUMBER 70

INSET A



INSET B





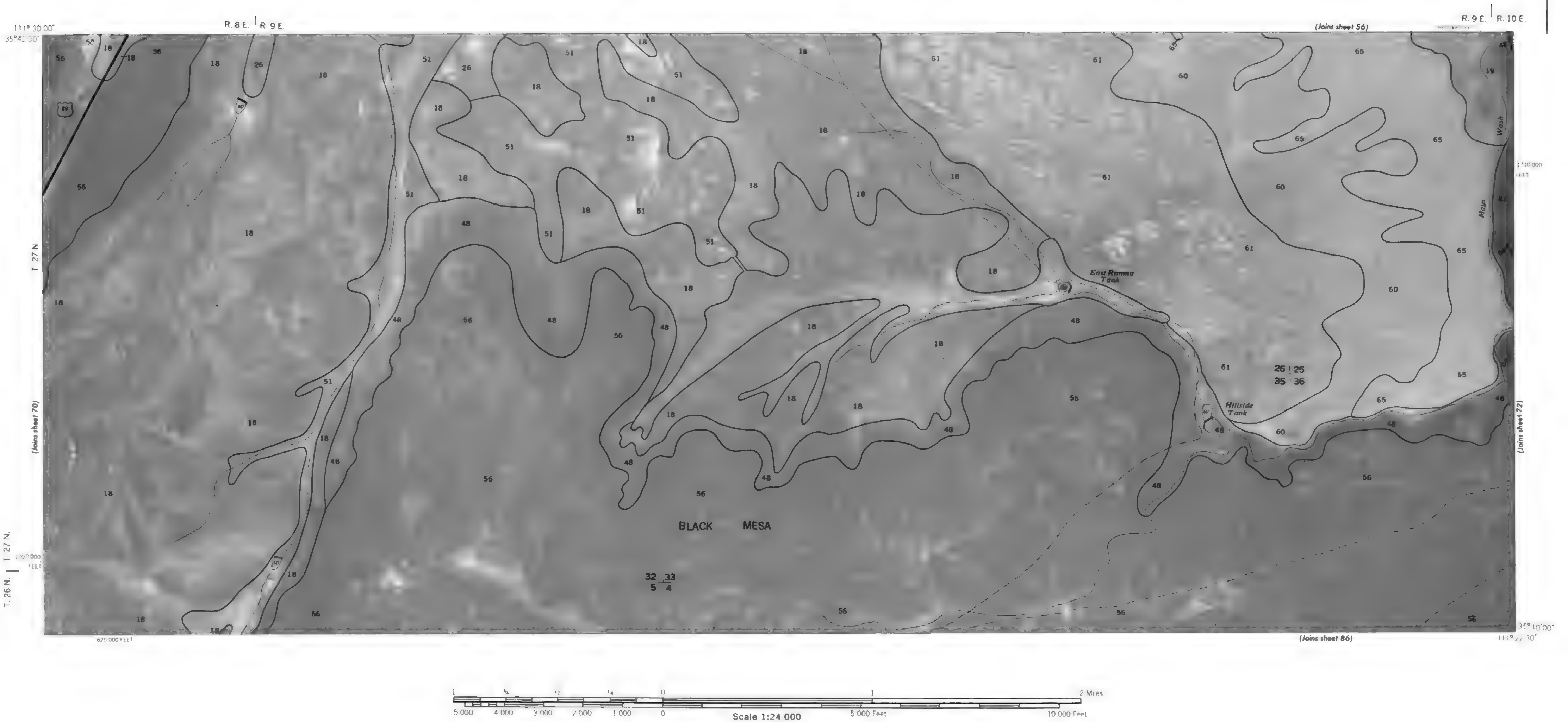
1000 AND 5000-FOOT GRID TICKS

1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

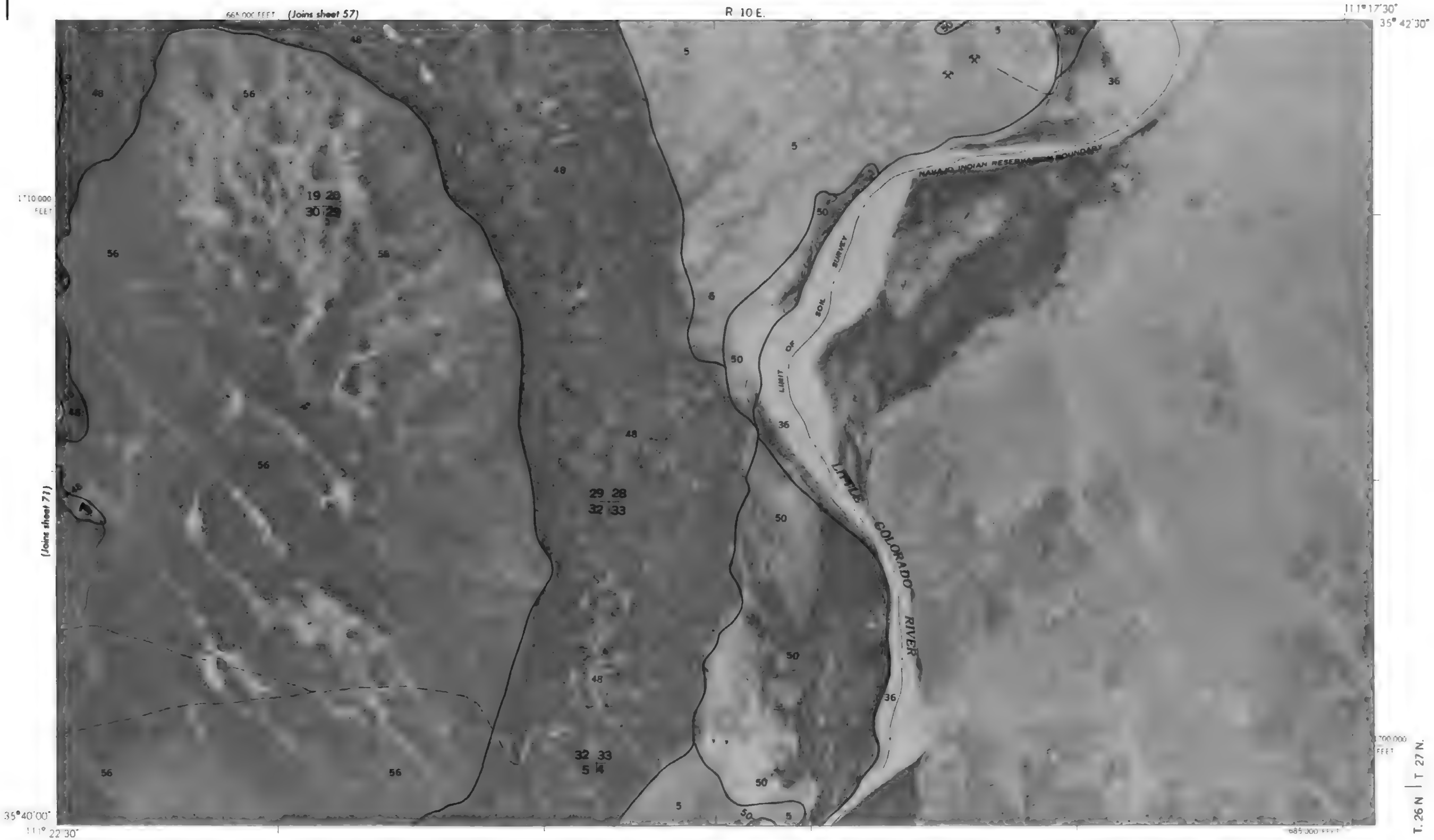
COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 70

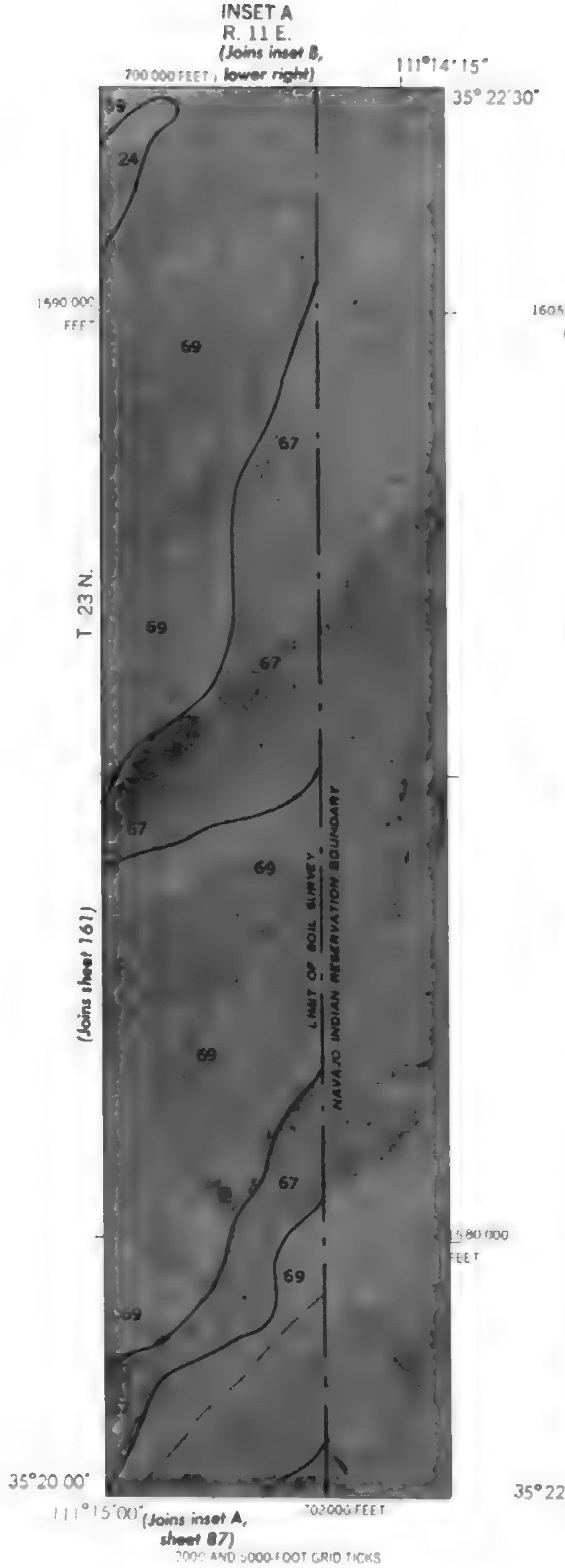


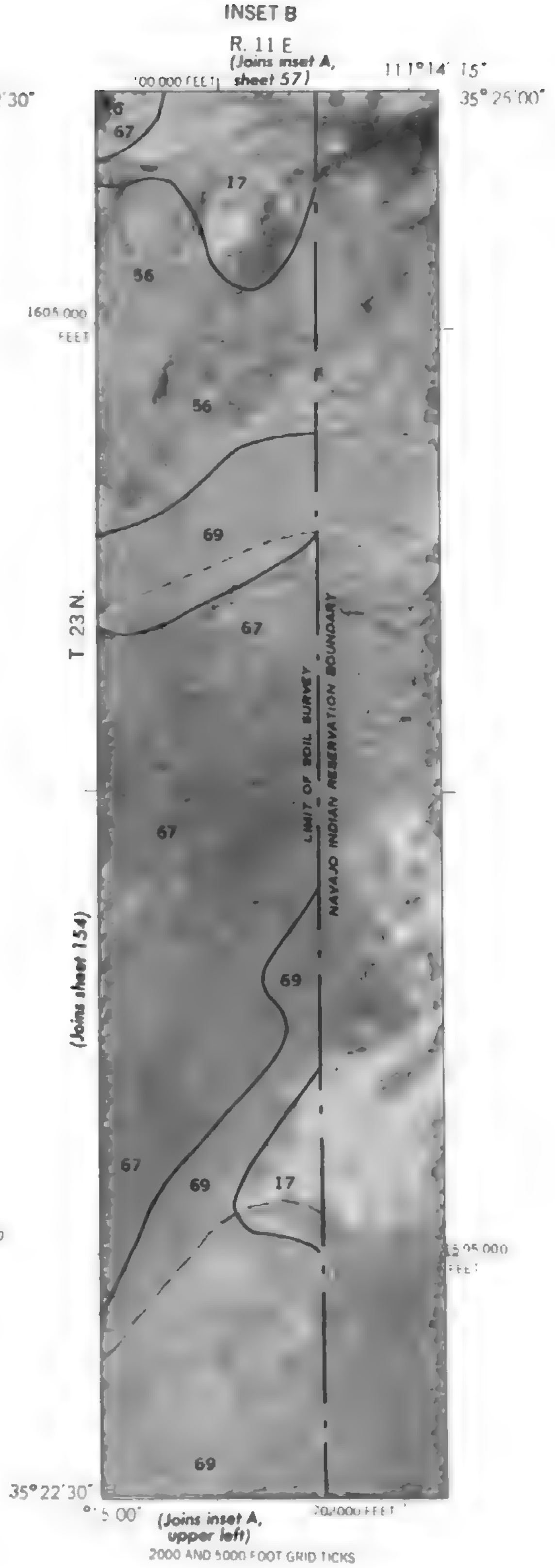
Scale 1:24 000

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 71

This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.







1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

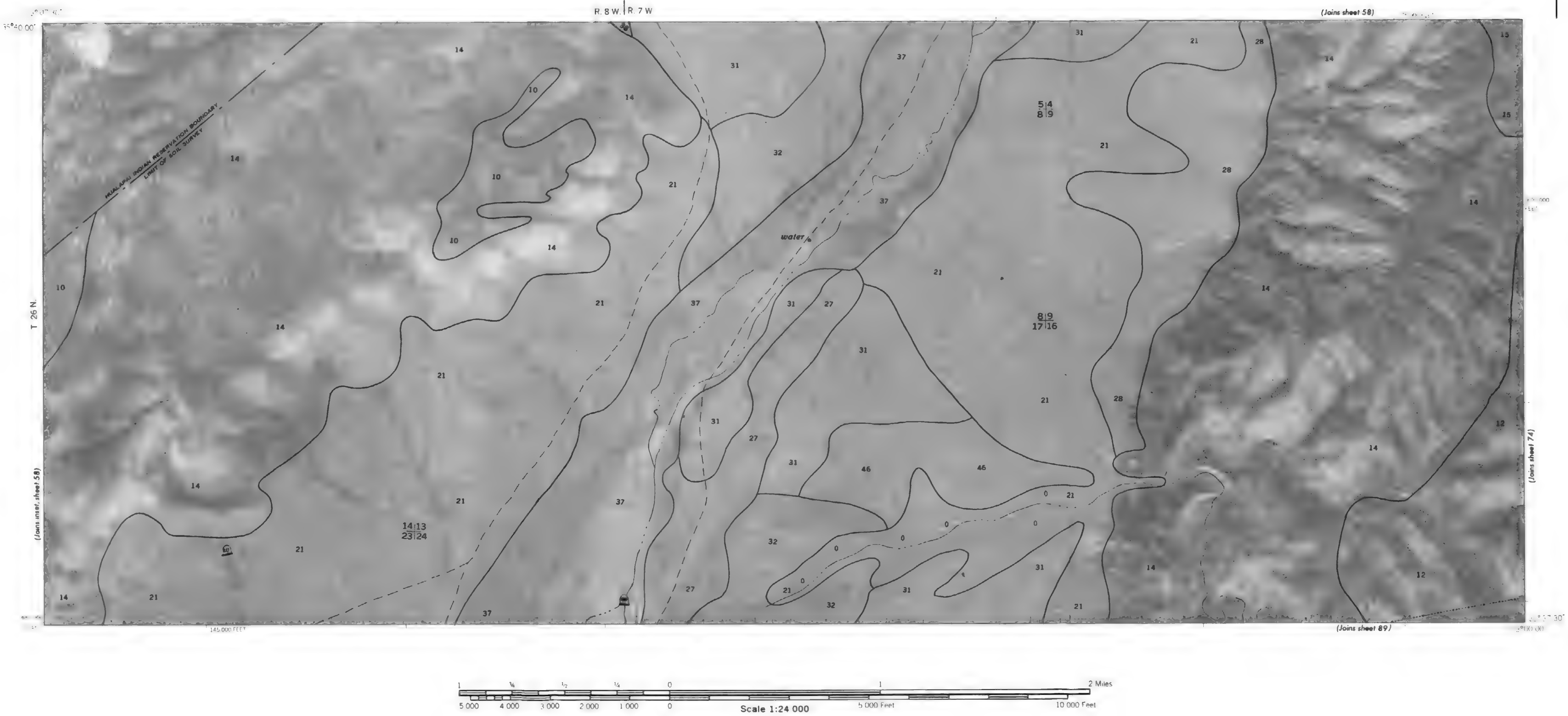
5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned

This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies

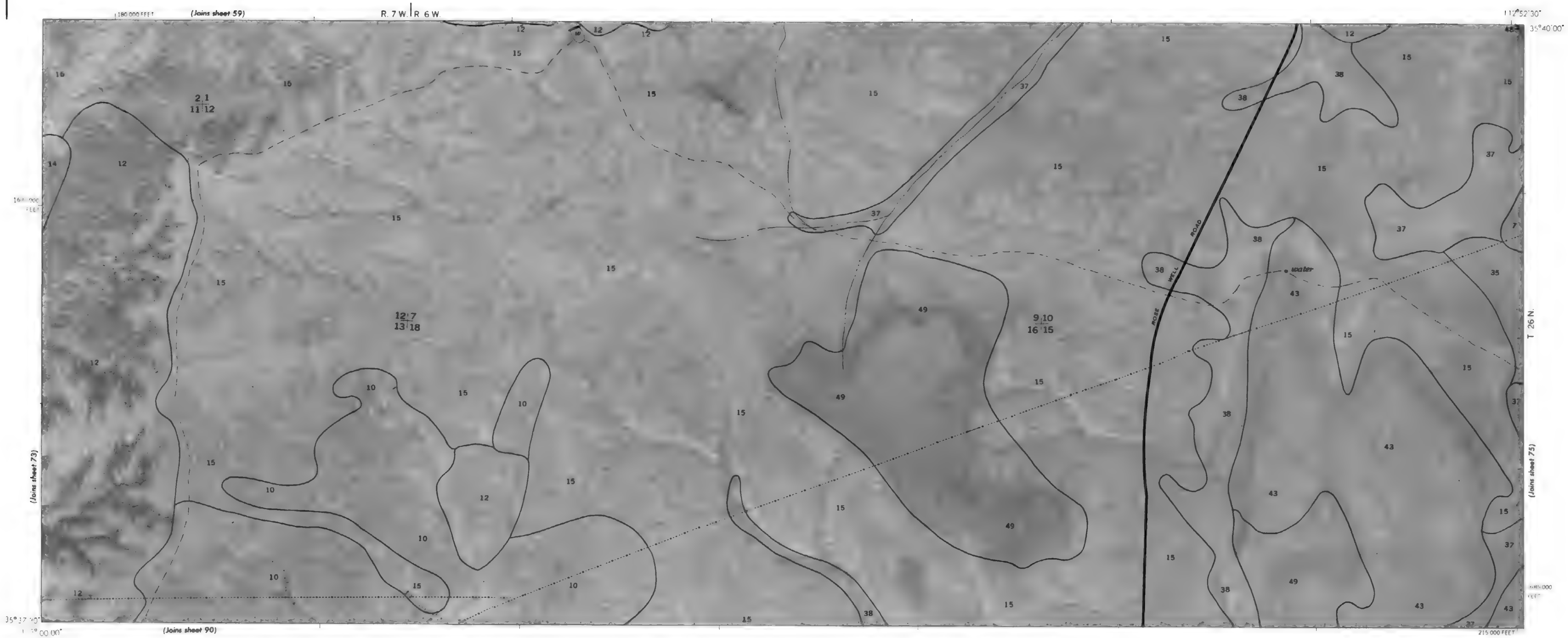
COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 72

73

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 73



COCONINO COUNTY, ARIZONA, CENTRAL PART — SHEET NUMBER 74

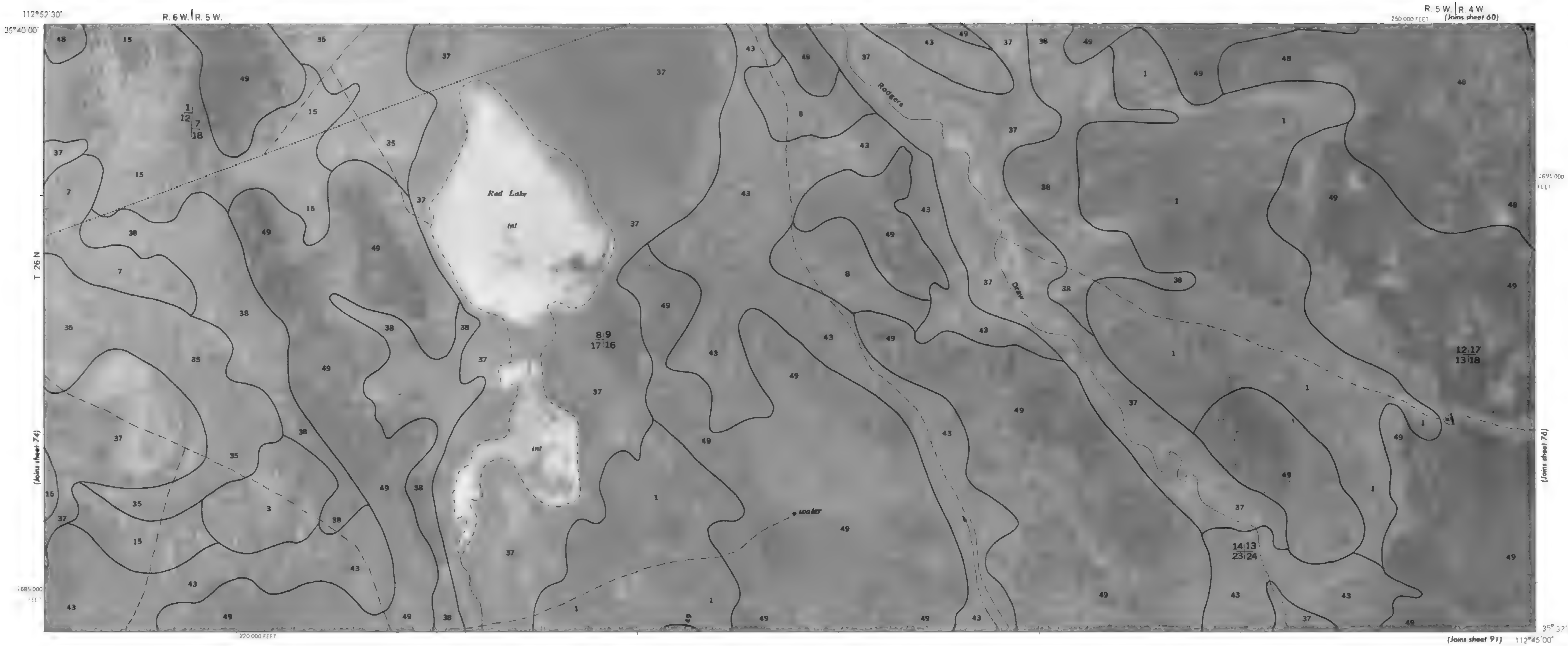


1 ¾ ½ ¼ 0 1 2 Miles
5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet
Scale 1:24 000

5 000 foot grid ticks based on state coordinate system. Land division corners if shown are approximately positioned

This map was compiled on 1972 and 1973 U.S. Department of The Interior Geological Survey orthophotography by the U.S. Department of Agriculture Soil Conservation Service and cooperating agencies

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 74

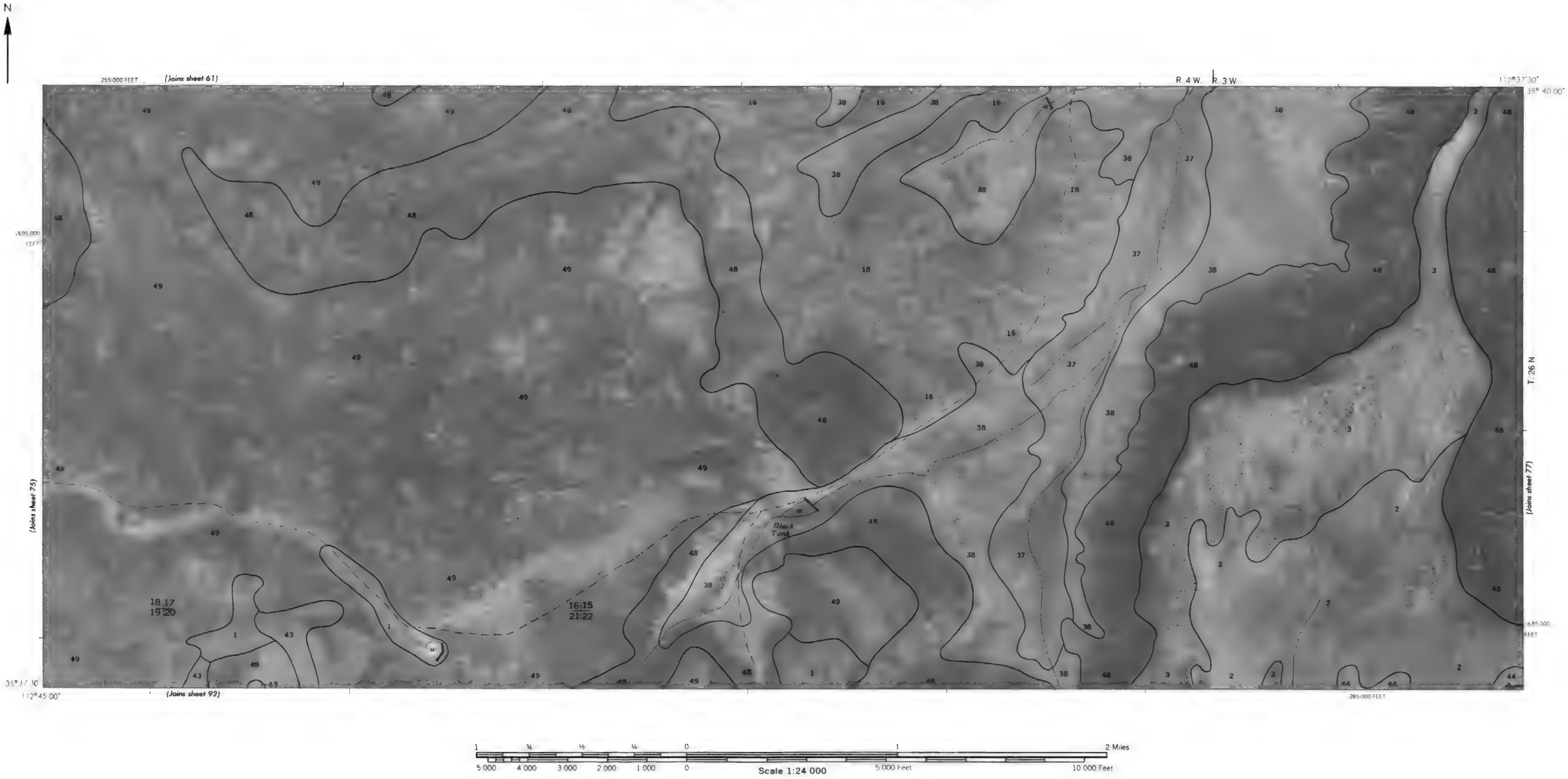


1 ¾ ½ ¼ 0 1 2 Miles
5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet
Scale 1:24 000

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 75

This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotography by the U.S. Department of Agriculture Soil Conservation Service and cooperating agencies.
5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

COCONINO COUNTY, ARIZONA, CENTRAL PART — SHEET NUMBER 76



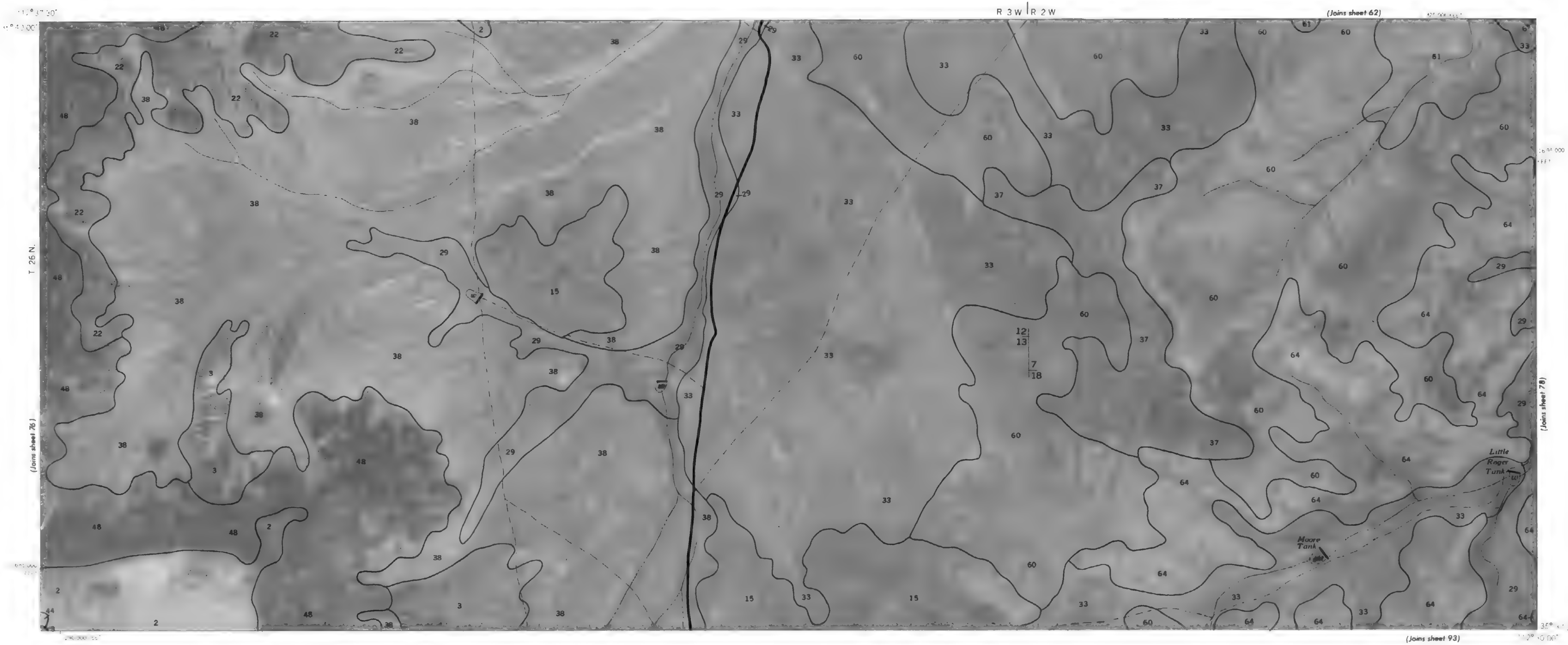
5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.
This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 76

N

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 77

This map was compiled on 1972 and 1973 U.S. Department of The Interior Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. 5,000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

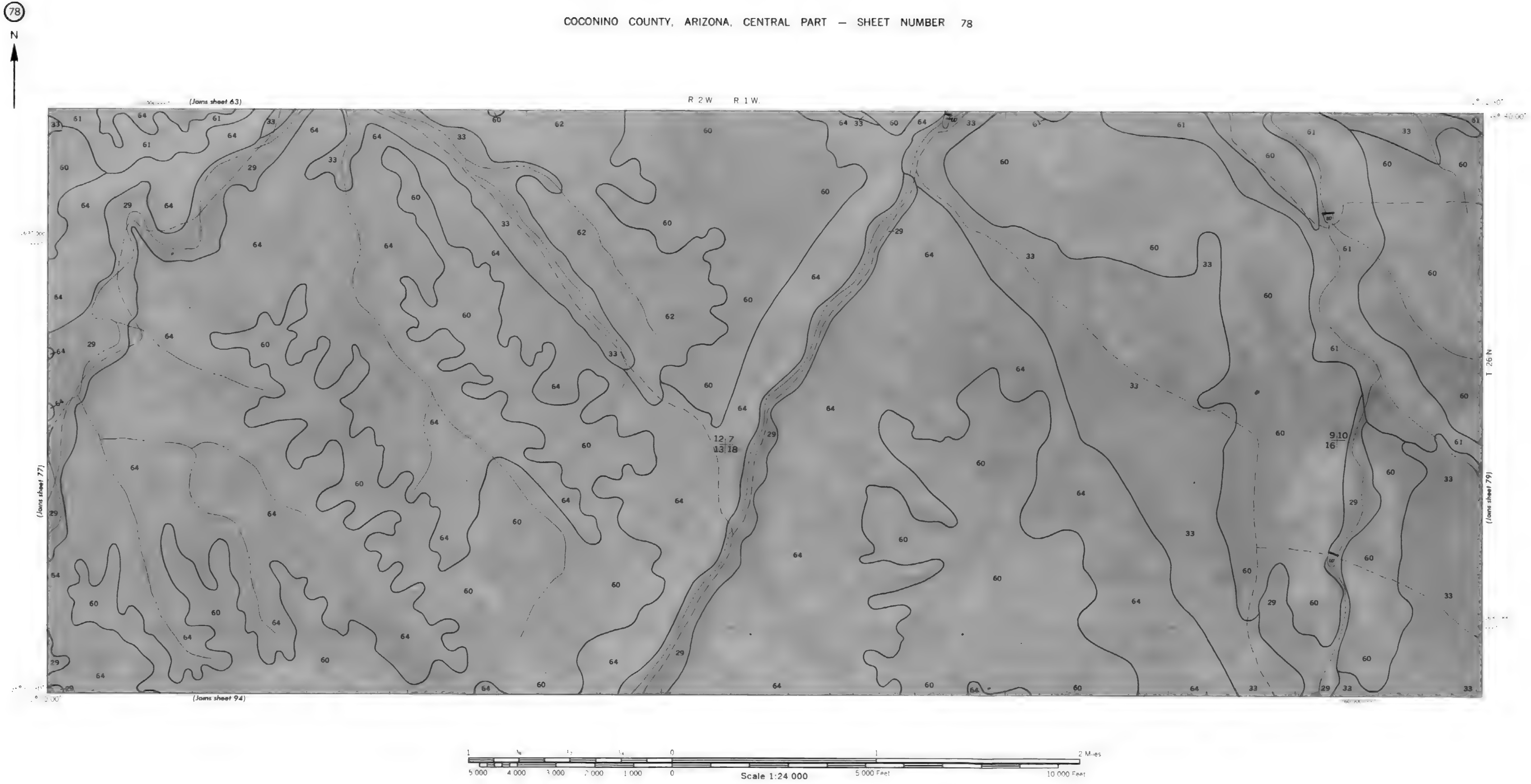


Scale 1:24 000

1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

COCONINO COUNTY, ARIZONA, CENTRAL PART — SHEET NUMBER 78



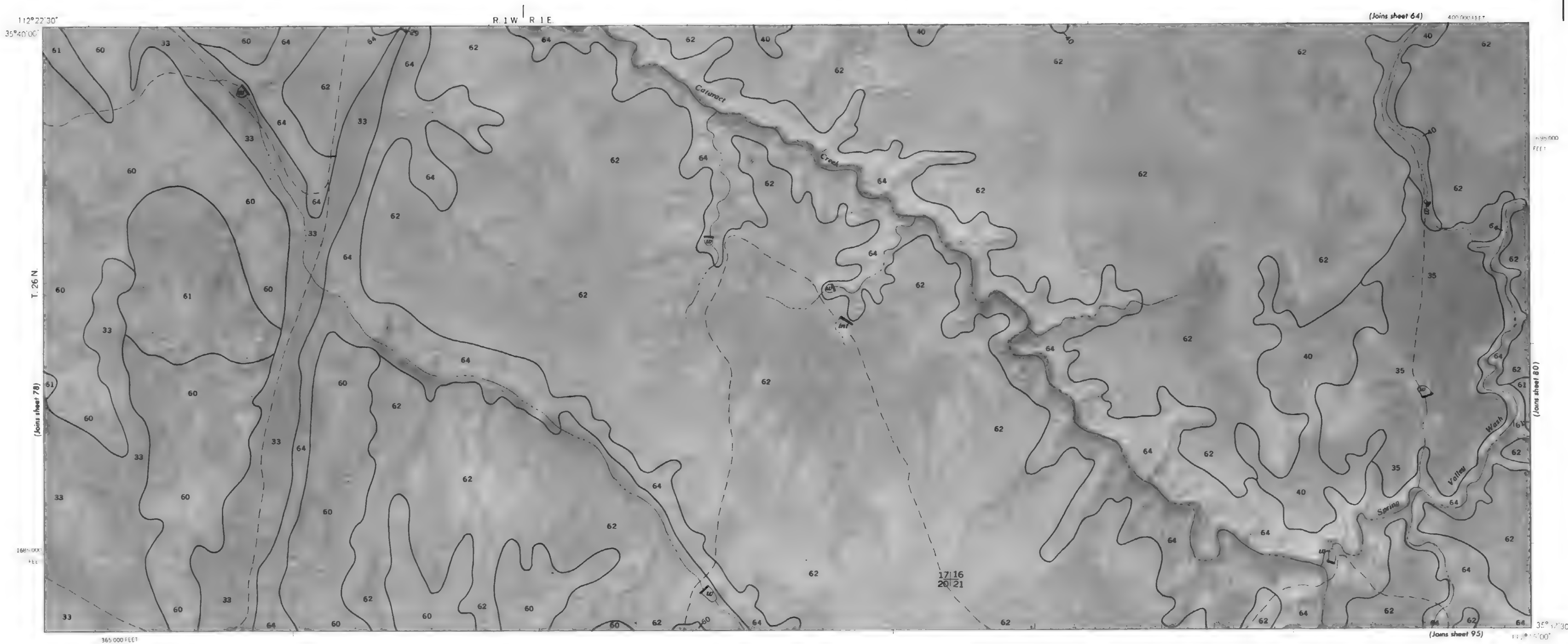
COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 78

(79)

N

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 79

This map was compiled on 1972 and 1973 U.S. Department of the Interior, Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

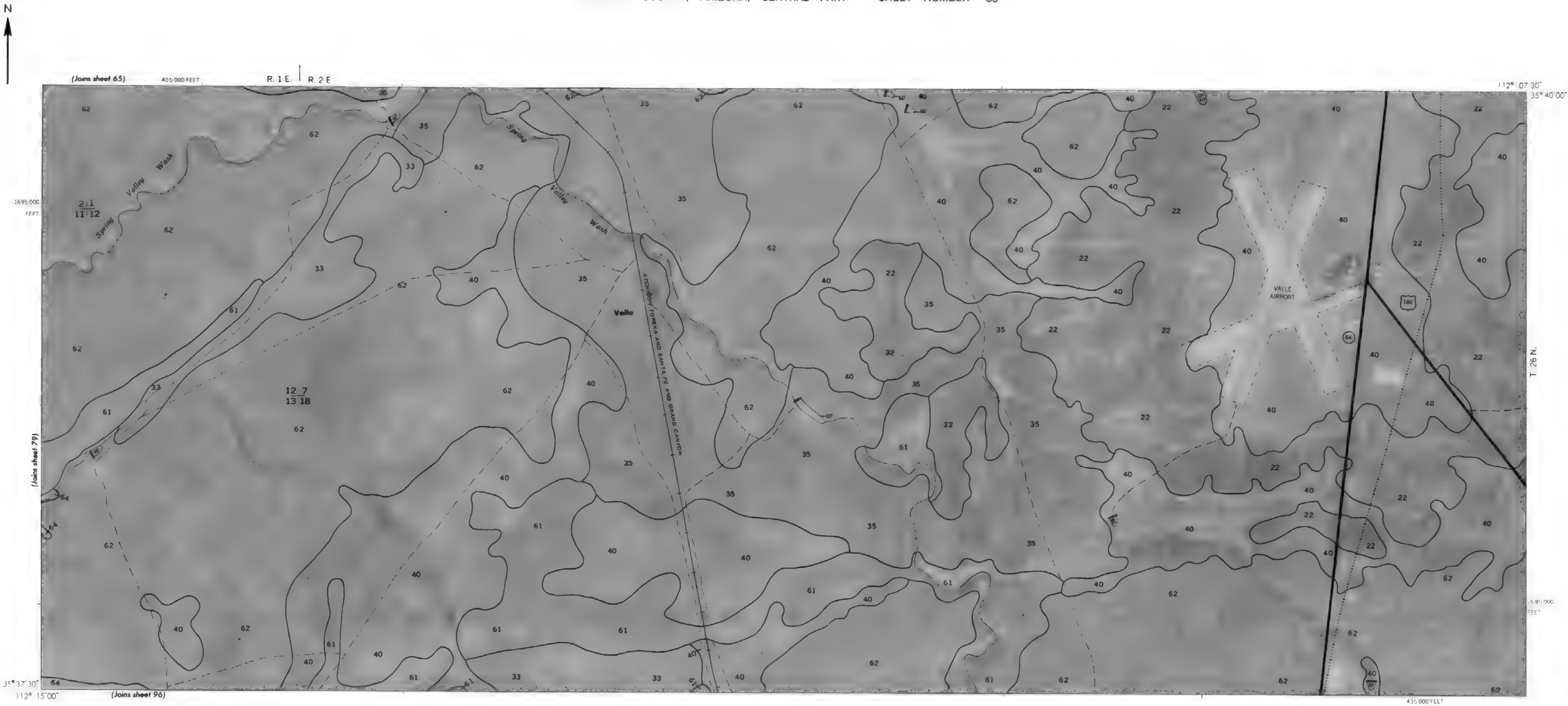


1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

COCONINO COUNTY, ARIZONA, CENTRAL PART — SHEET NUMBER 80



1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

5 000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

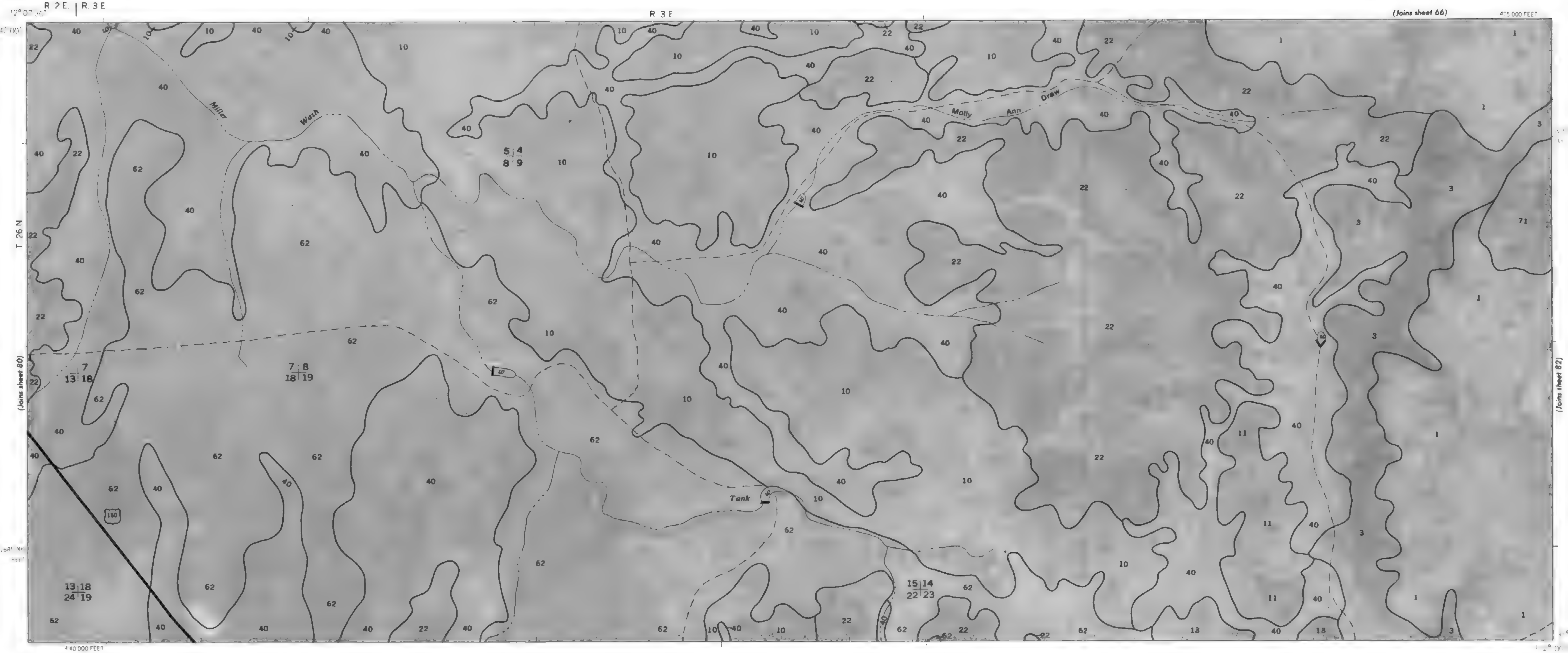
COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 80

81

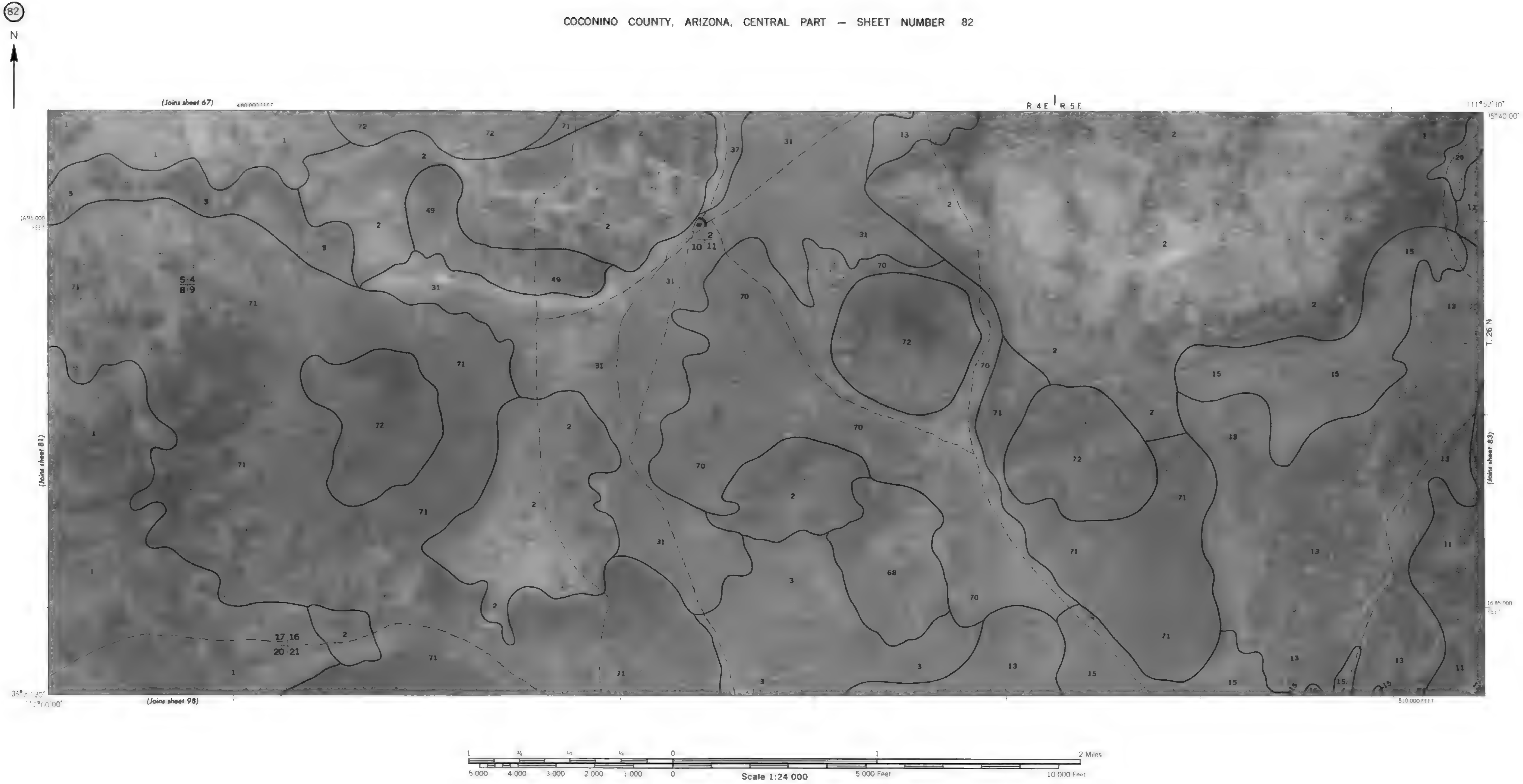
N

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 81

This map was compiled on 1972 and 1973 U.S. Department of the Interior, Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.



1 ¾ ½ ¼ 0 1 2 Miles
5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet
Scale 1:24 000



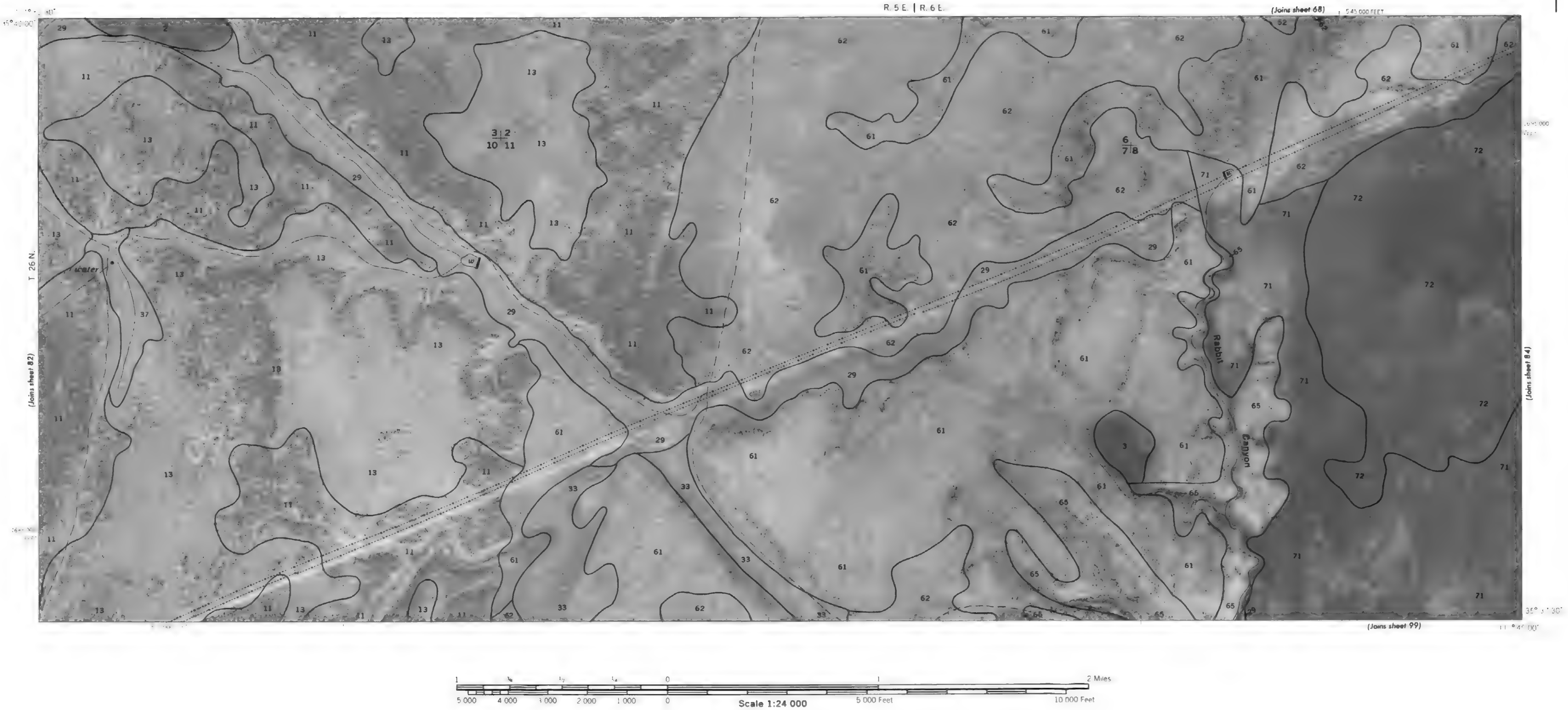
5 000 foot grid ticks based on state coordinate system and land division corners, if shown are approximately positioned

This map was compiled on 1972 and 1973 U.S. Department of the Interior, Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 82

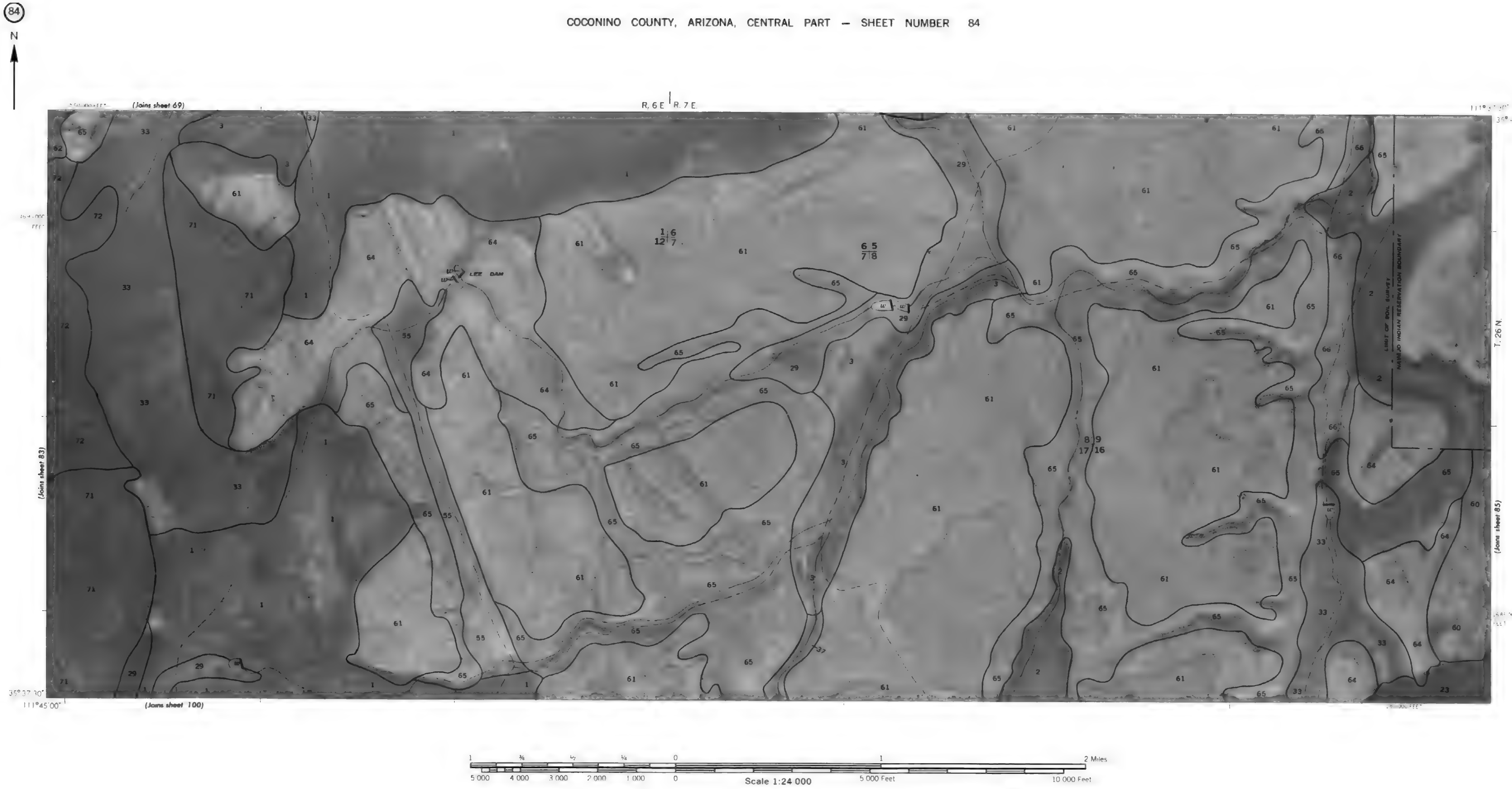
COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 83

This map was compiled on 1972 and 1973 U.S. Department of the Interior, Geological Survey orthophotographs by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.



Scale 1:24 000

COCONINO COUNTY, ARIZONA, CENTRAL PART — SHEET NUMBER 84



5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

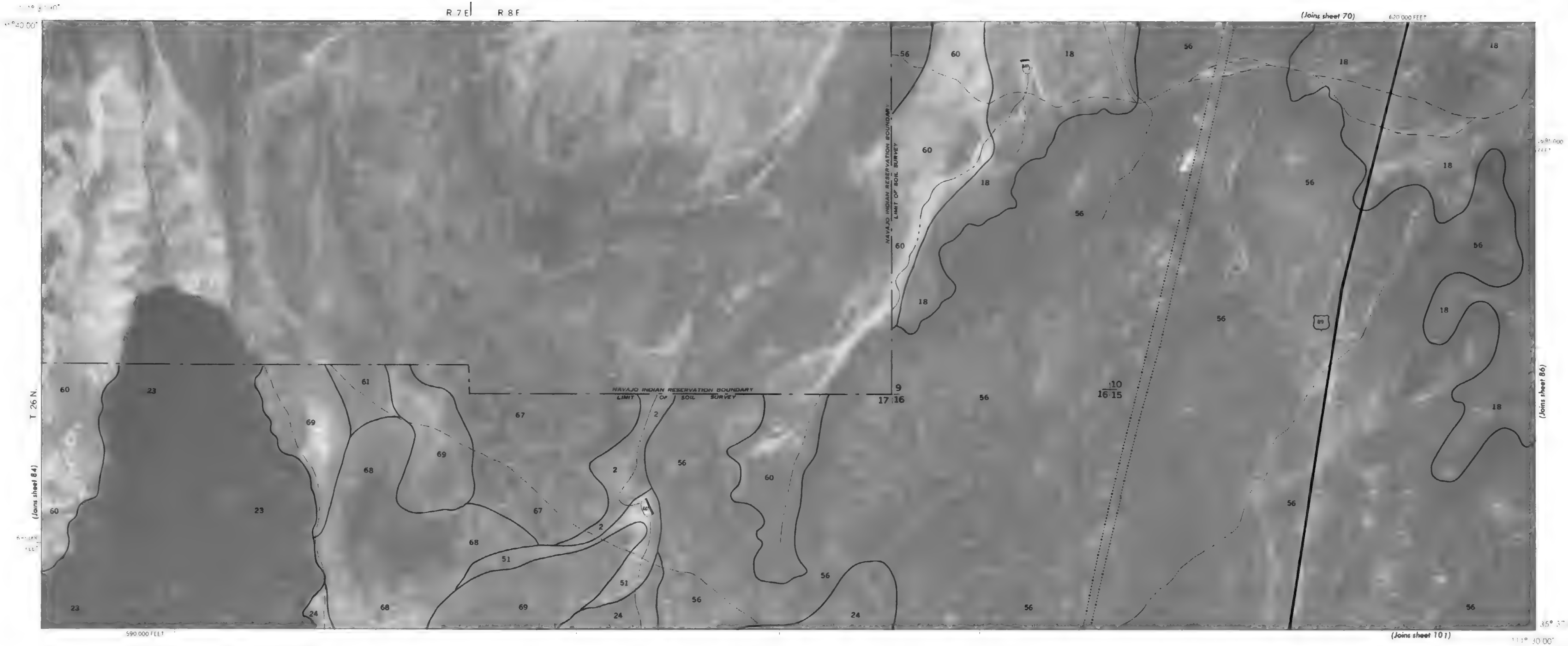
This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

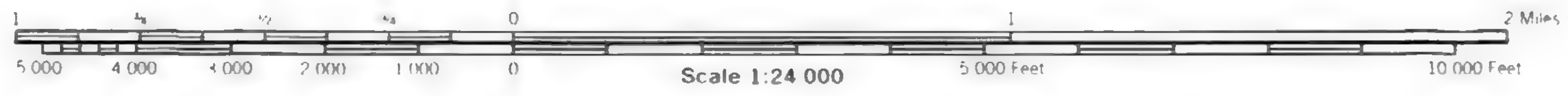
85

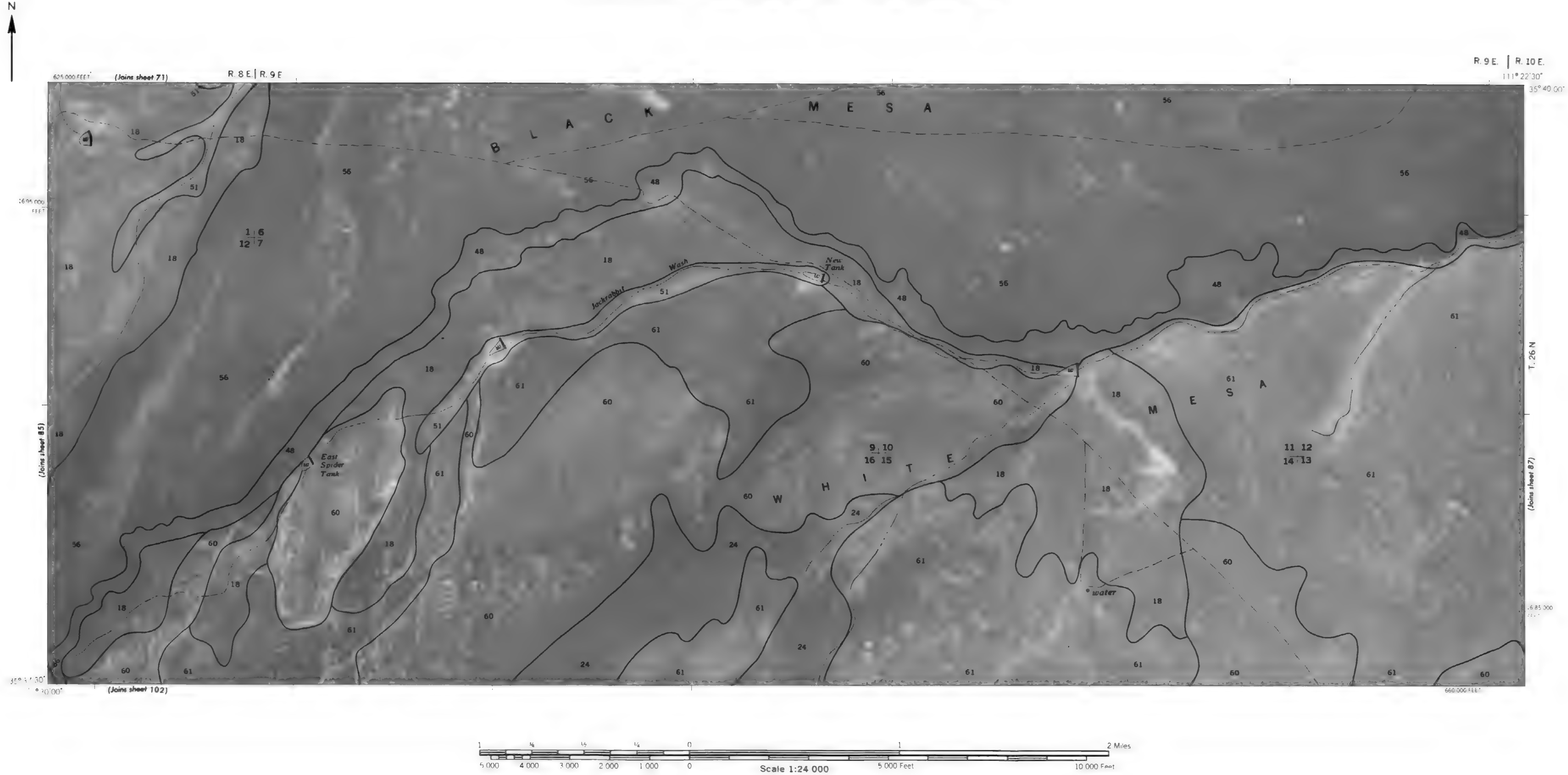
N

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 85

This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotographs by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. 5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.







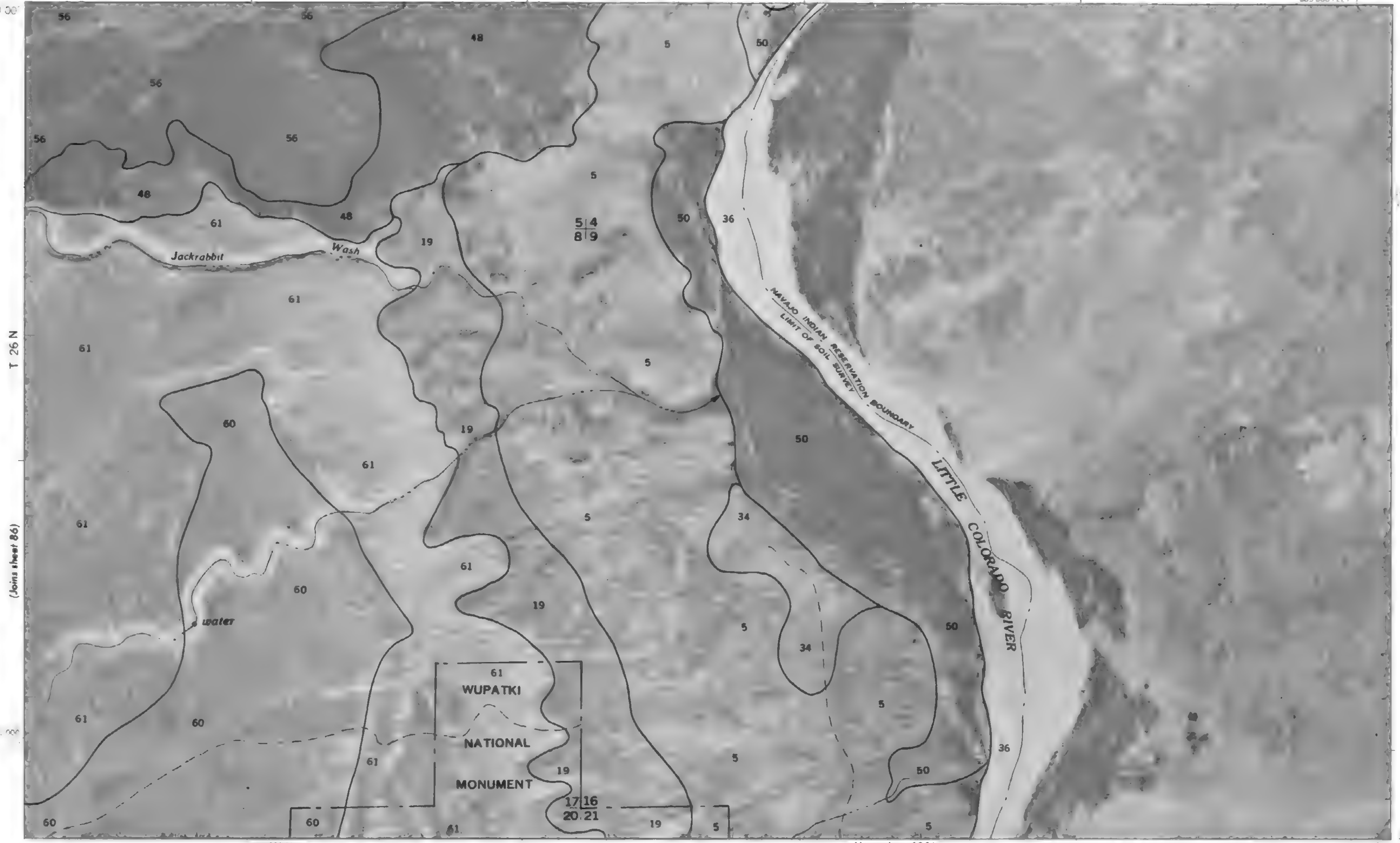
5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.
This map was compiled on 1972 and 1973 U.S. Department of the Interior, Geological Survey, orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 86

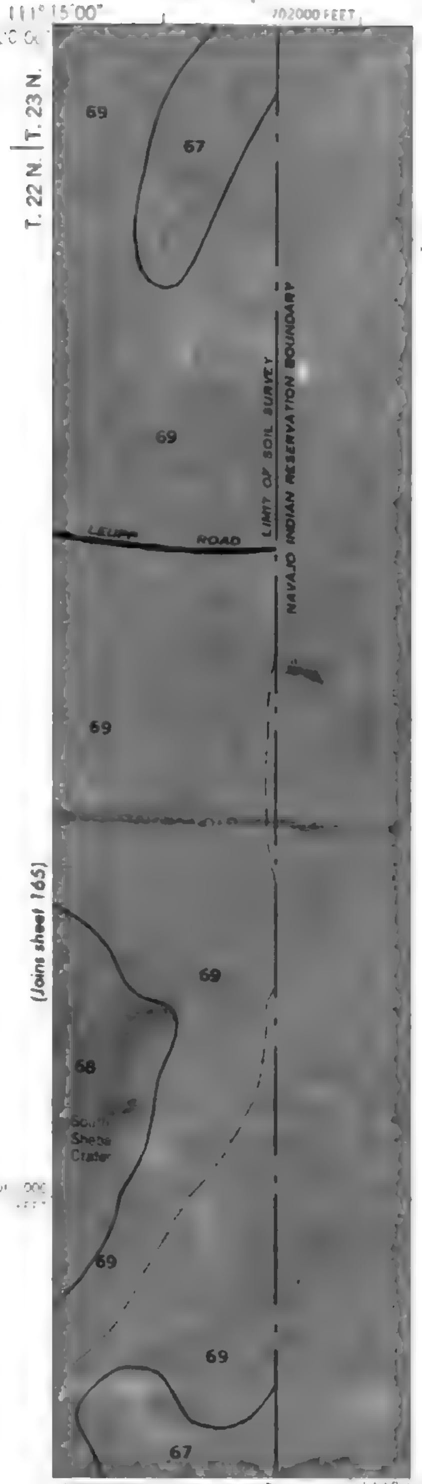
87

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 87

This map was compiled on 1972 and 1973 U.S. Department of the Interior, Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5 000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

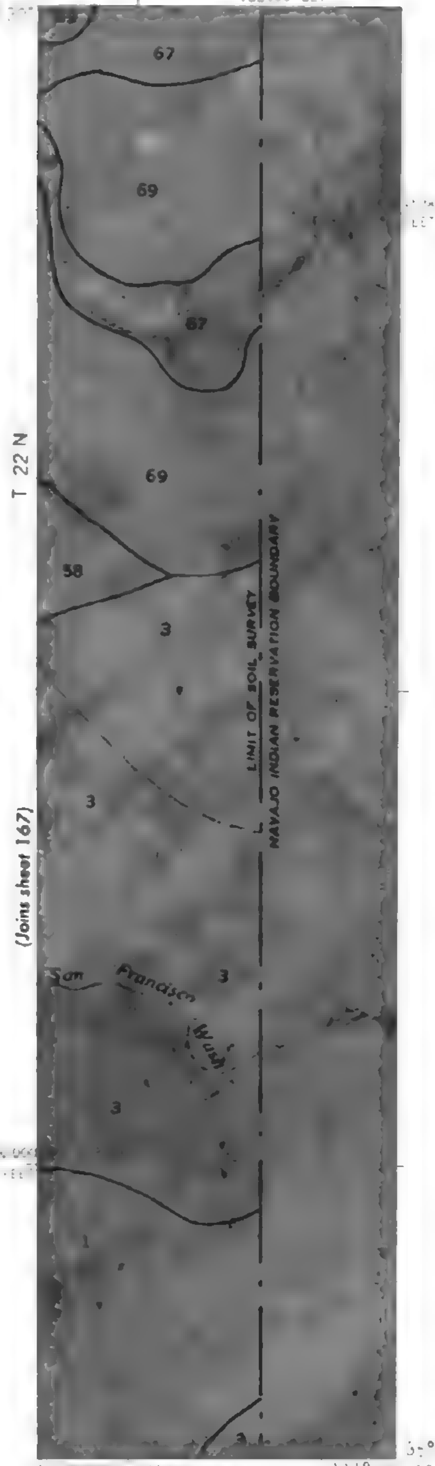


INSET A
R. 11 E.
(Joins inset A, sheet 72)



2000 AND 5000-FOOT GRID TICKS

INSET B
R. 11 E.
(Joins inset A, lower left)

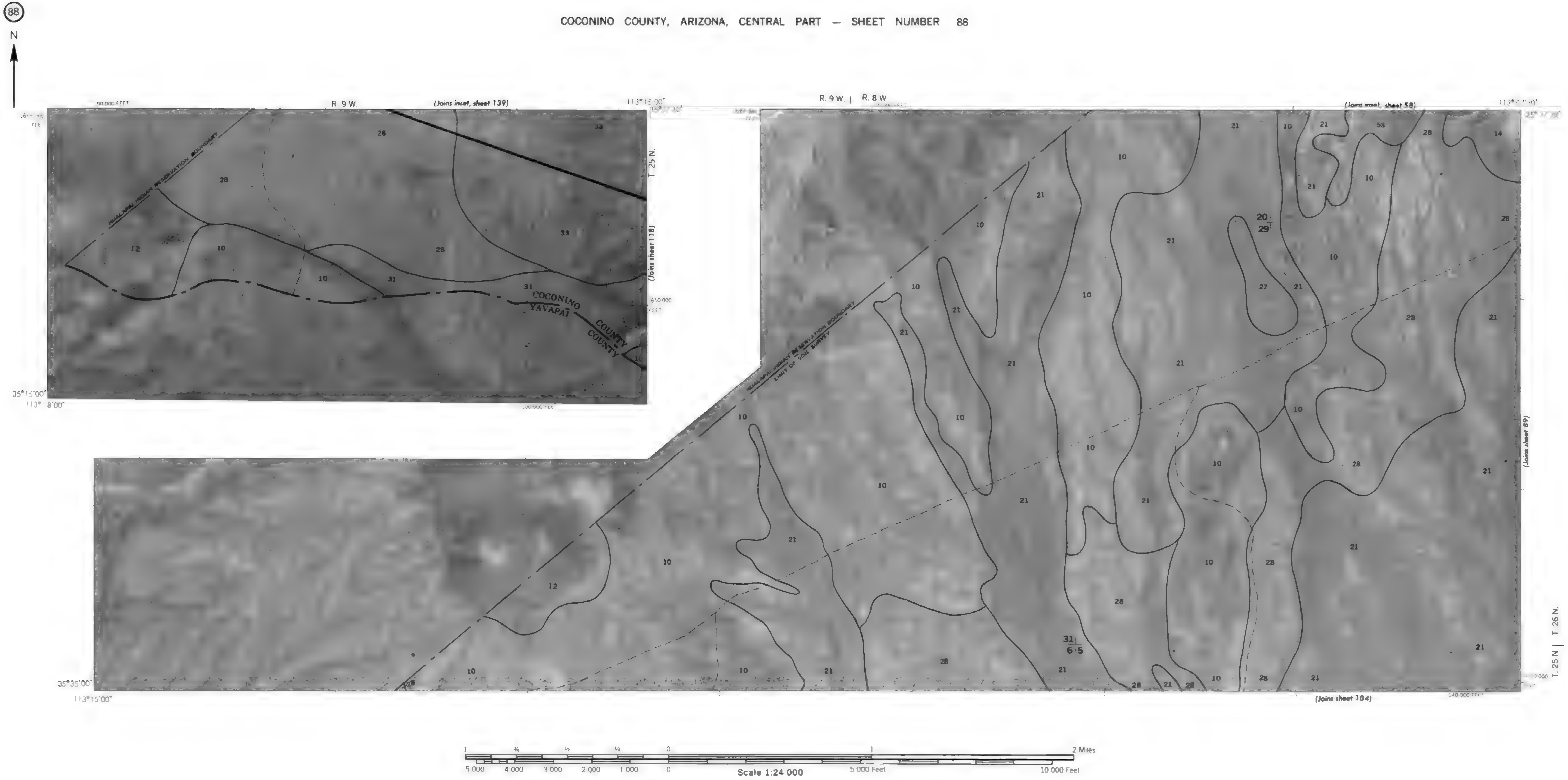


2000 AND 5000-FOOT GRID TICKS

N

1 ¾ ½ ¼ 0 1 2 Miles
5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

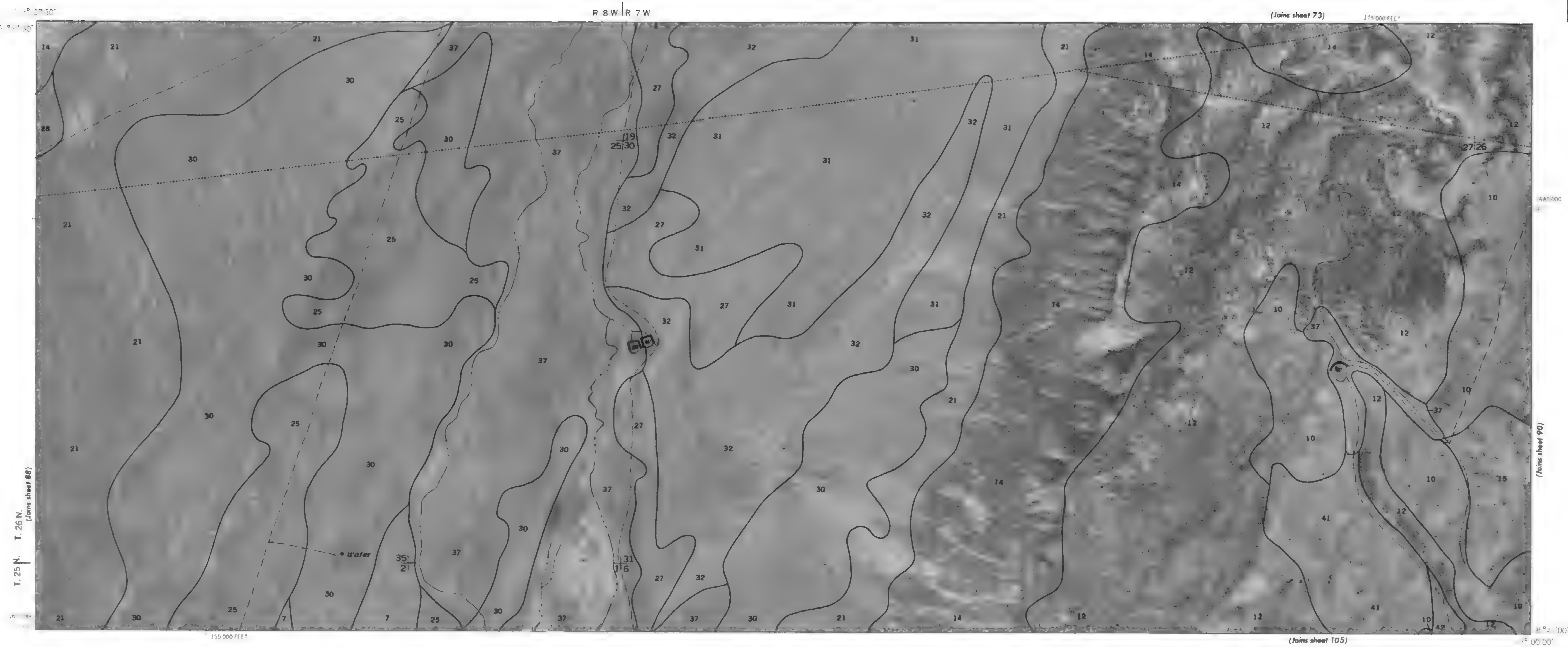


COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 88

N

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 89

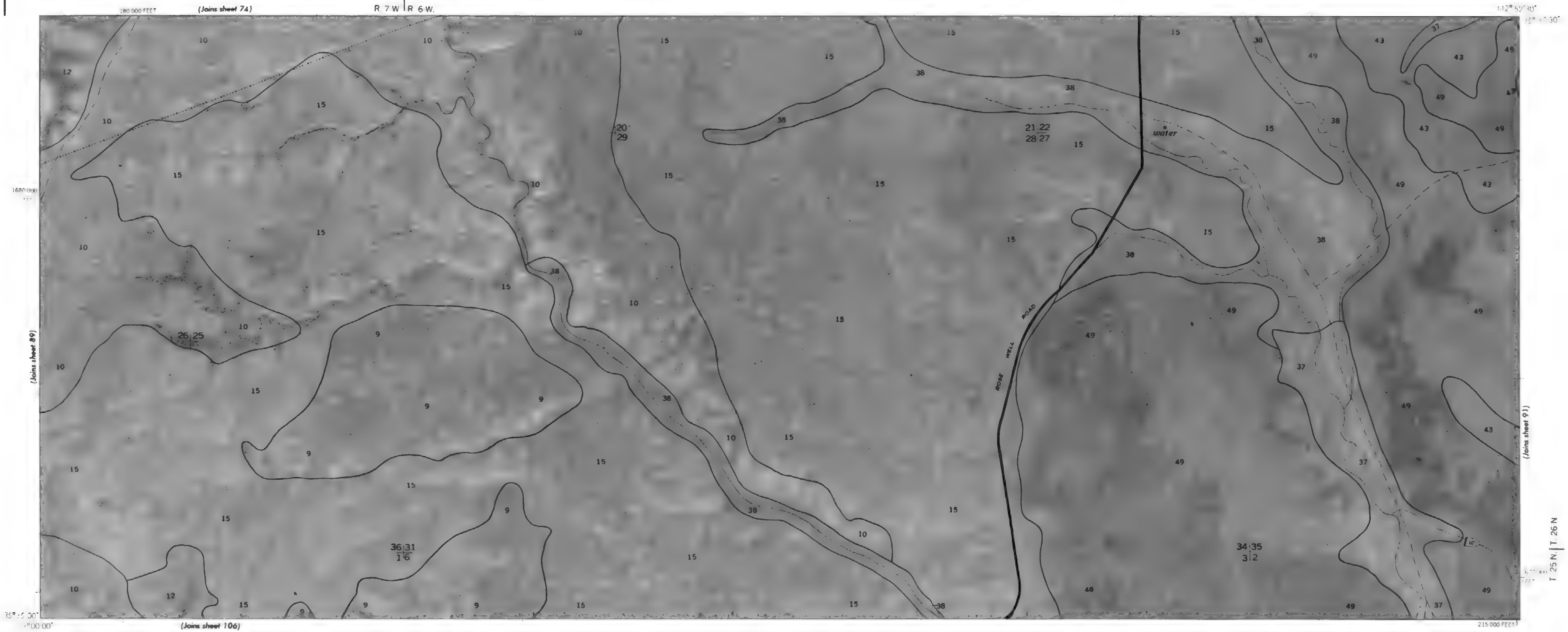
This map was compiled on 1972 and 1973 U.S. Department of the Interior, Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.



Scale 1:24 000

N

COCONINO COUNTY, ARIZONA, CENTRAL PART — SHEET NUMBER 90



1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

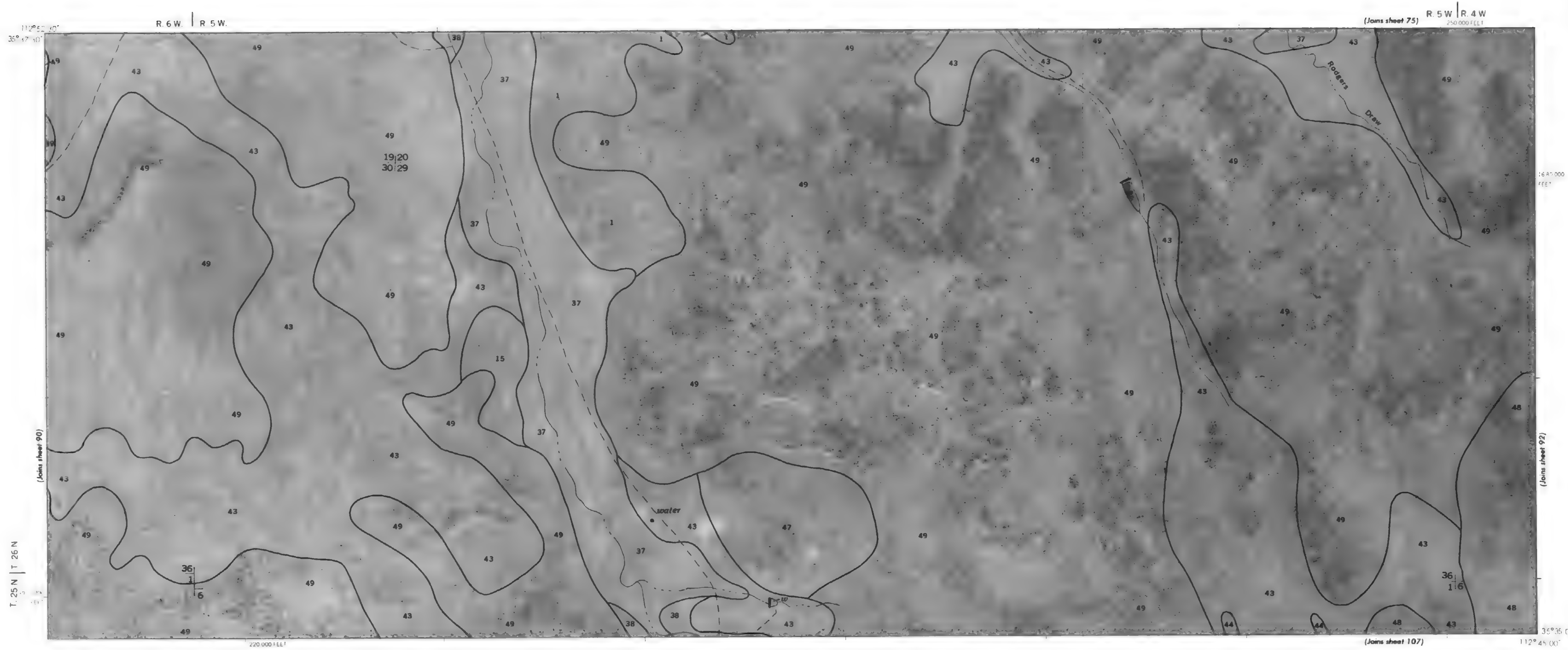
This map was compiled on 1972 and 1973 U.S. Department of the Interior, Geological Survey orthophotographs by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 90

N

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 91

This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5 000 foot grid ticks based on state coordinate system. Land division corners if shown are approximately positioned.



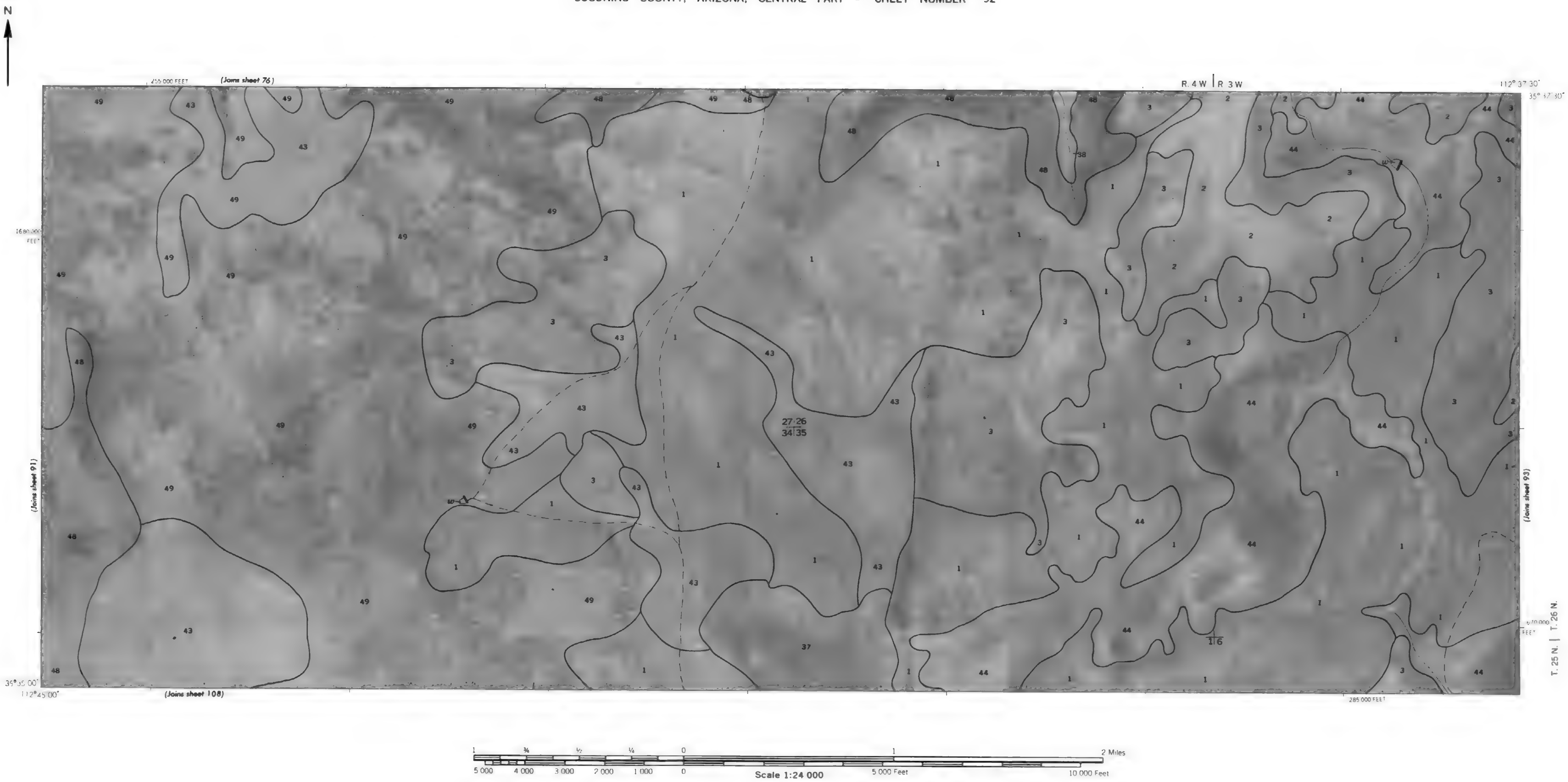
Scale 1:24 000

5 000 Feet

10 000 Feet

2 Miles

COCONINO COUNTY, ARIZONA, CENTRAL PART — SHEET NUMBER 92



5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

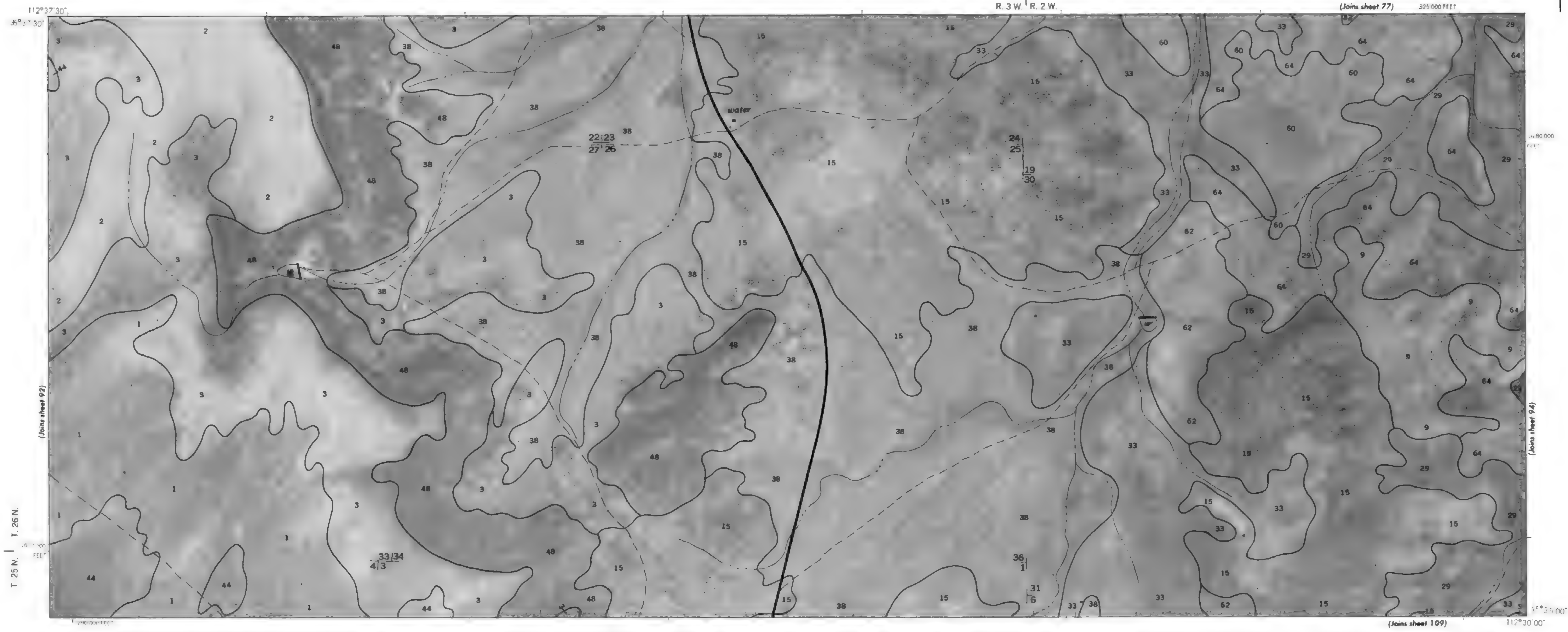
This map was compiled on 1972 and 1973 U.S. Department of the Interior, Geological Survey orthophotographs by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 92

93

N

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 93



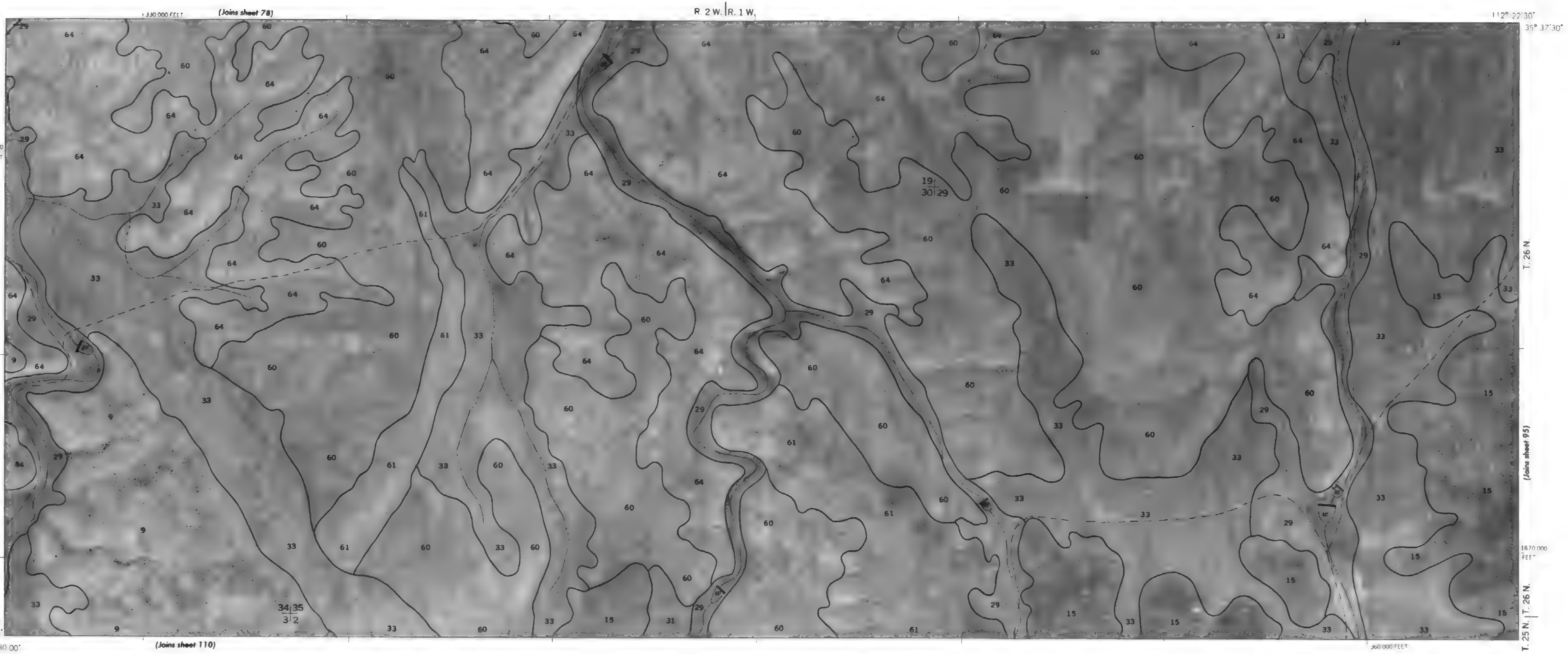
1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

COCONINO COUNTY, ARIZONA, CENTRAL PART — SHEET NUMBER 94

N



Scale 1:24 000

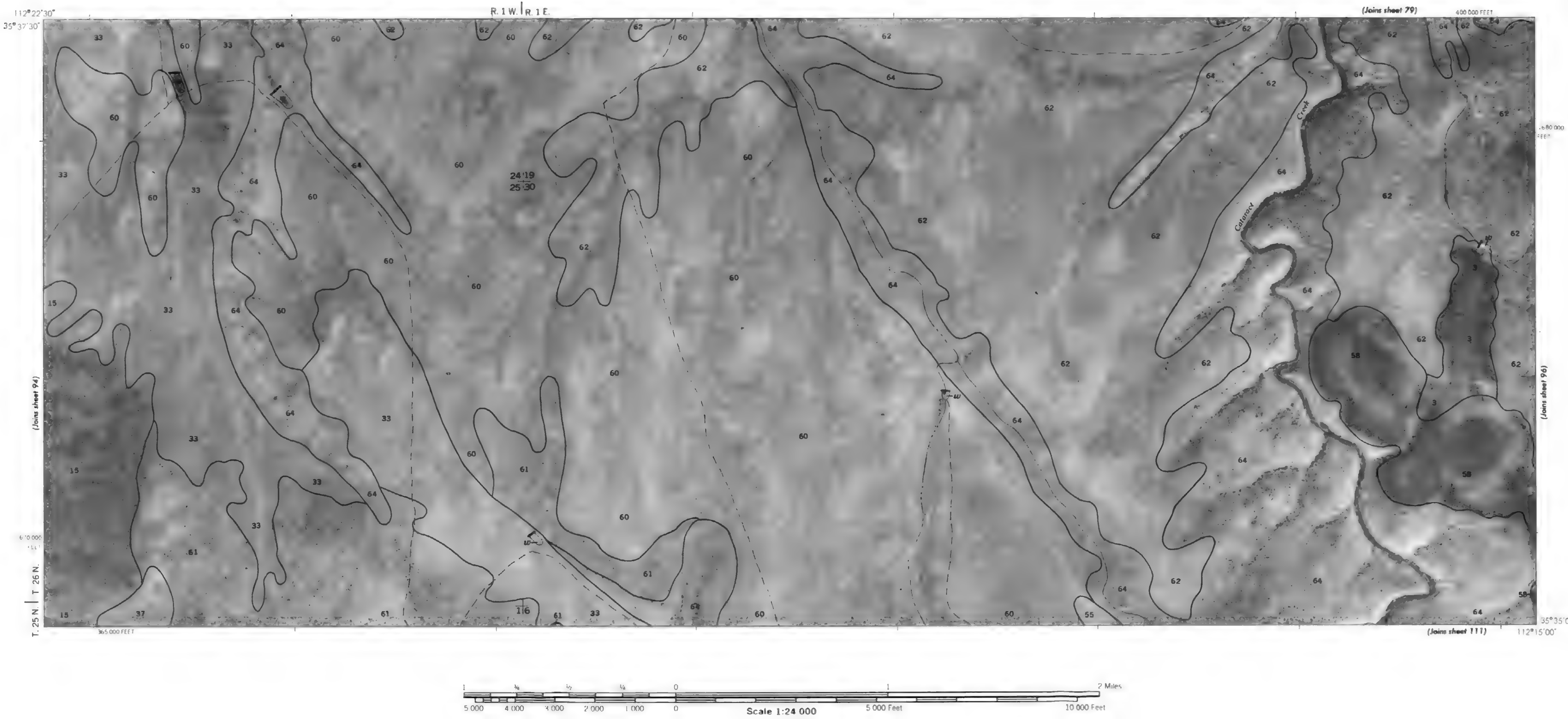
1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotography by the U.S. Department of Agriculture Soil Conservation Service and cooperating agencies.

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 94



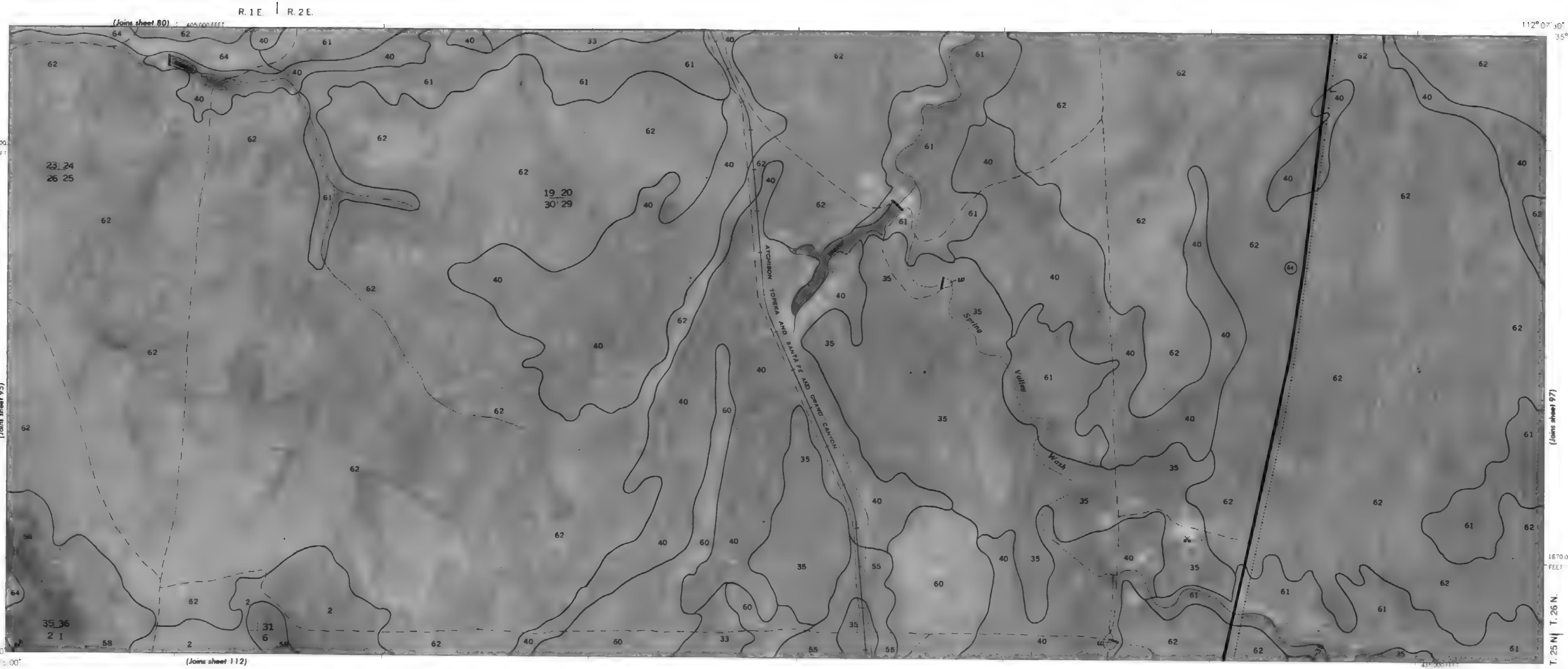
Scale 1:24 000

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 95

This map was compiled on 1972 and 1973 U.S. Department of the Interior, Geological Survey orthophotographs by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. 1,000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

96

COCONINO COUNTY, ARIZONA, CENTRAL PART — SHEET NUMBER 96



Scale 1:24 000

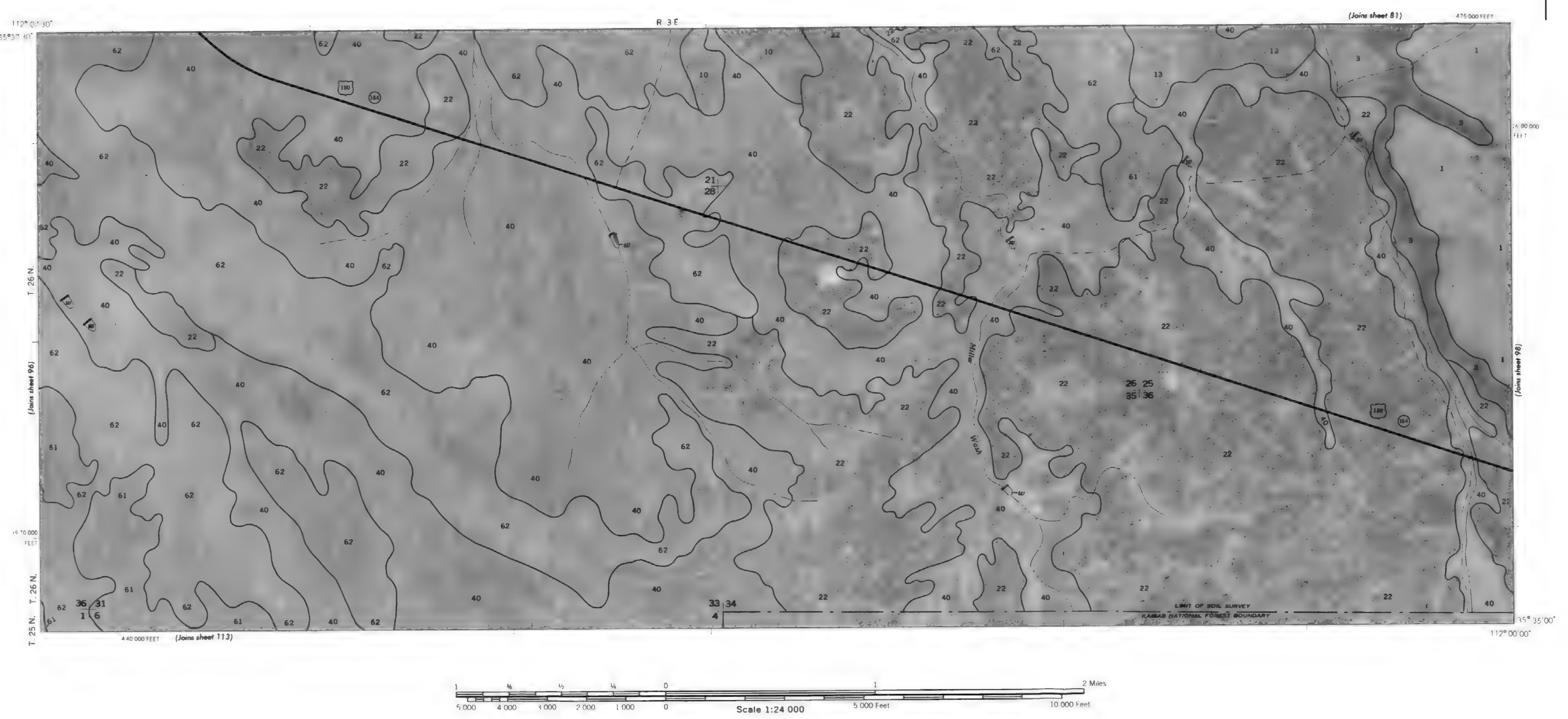
1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

5 000 foot grid ticks based on state coordinate system. Land division corners if shown are approximately positioned.

This map was compiled on 1972 and 1973 U.S. Department of the Interior, Geological Survey, orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 96



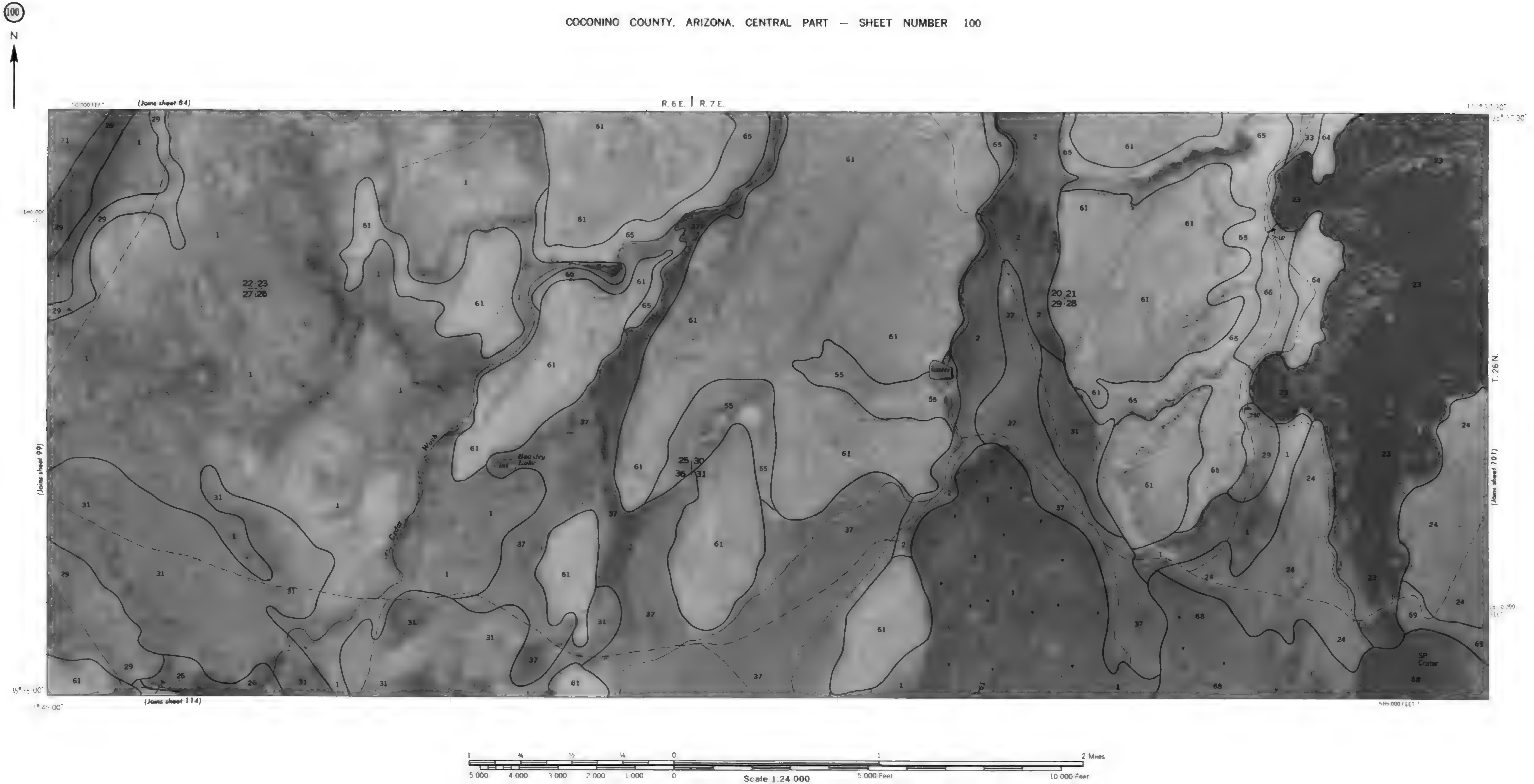
COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 97

This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotography by the U.S. Department of Agriculture Soil Conservation Service and cooperating agencies.
5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

COCONINO COUNTY, ARIZONA, CENTRAL PART — SHEET NUMBER 98

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 99

This map was compiled on 1972 and 1973 U.S. Department of the Interior, Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.



5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

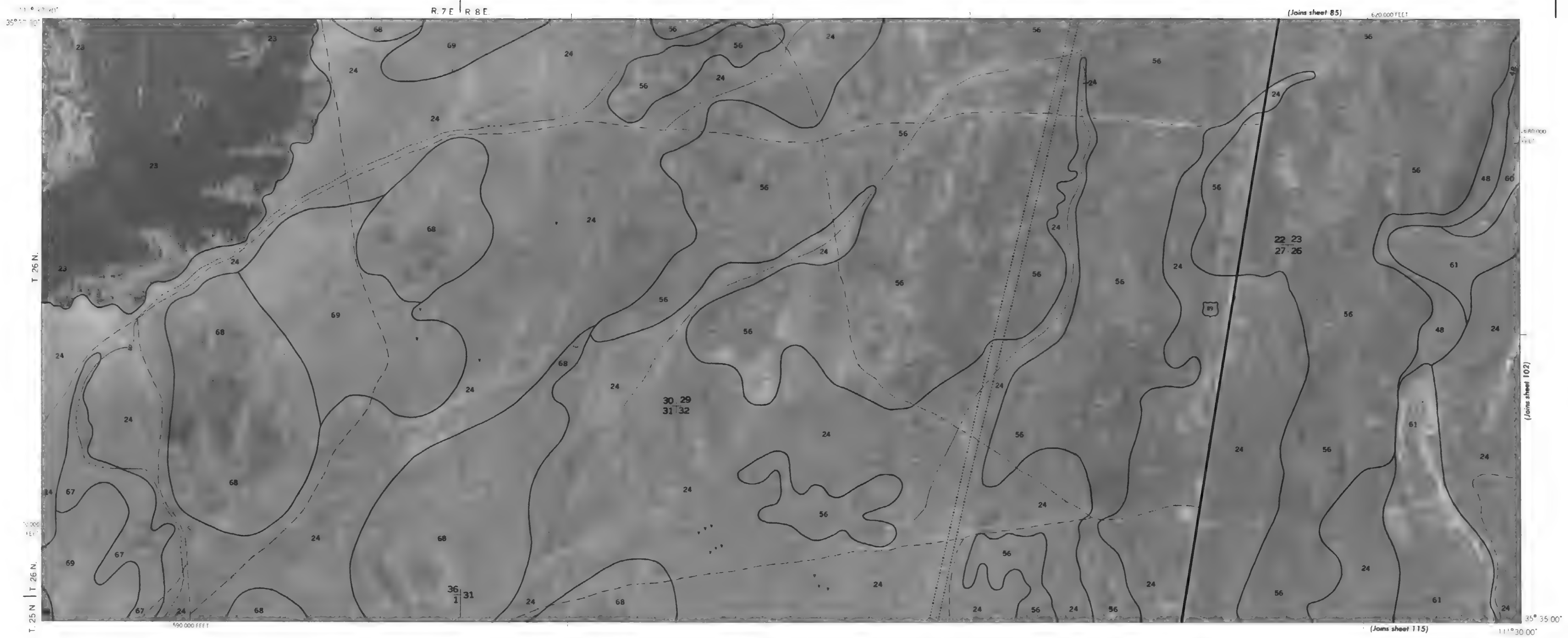
COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 100

101

N

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 101

This map was compiled on 1972 and 1973 U.S. Department of The Interior Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.



Scale 1:24 000

1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

COCONINO COUNTY, ARIZONA, CENTRAL PART — SHEET NUMBER 102

1 ½ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

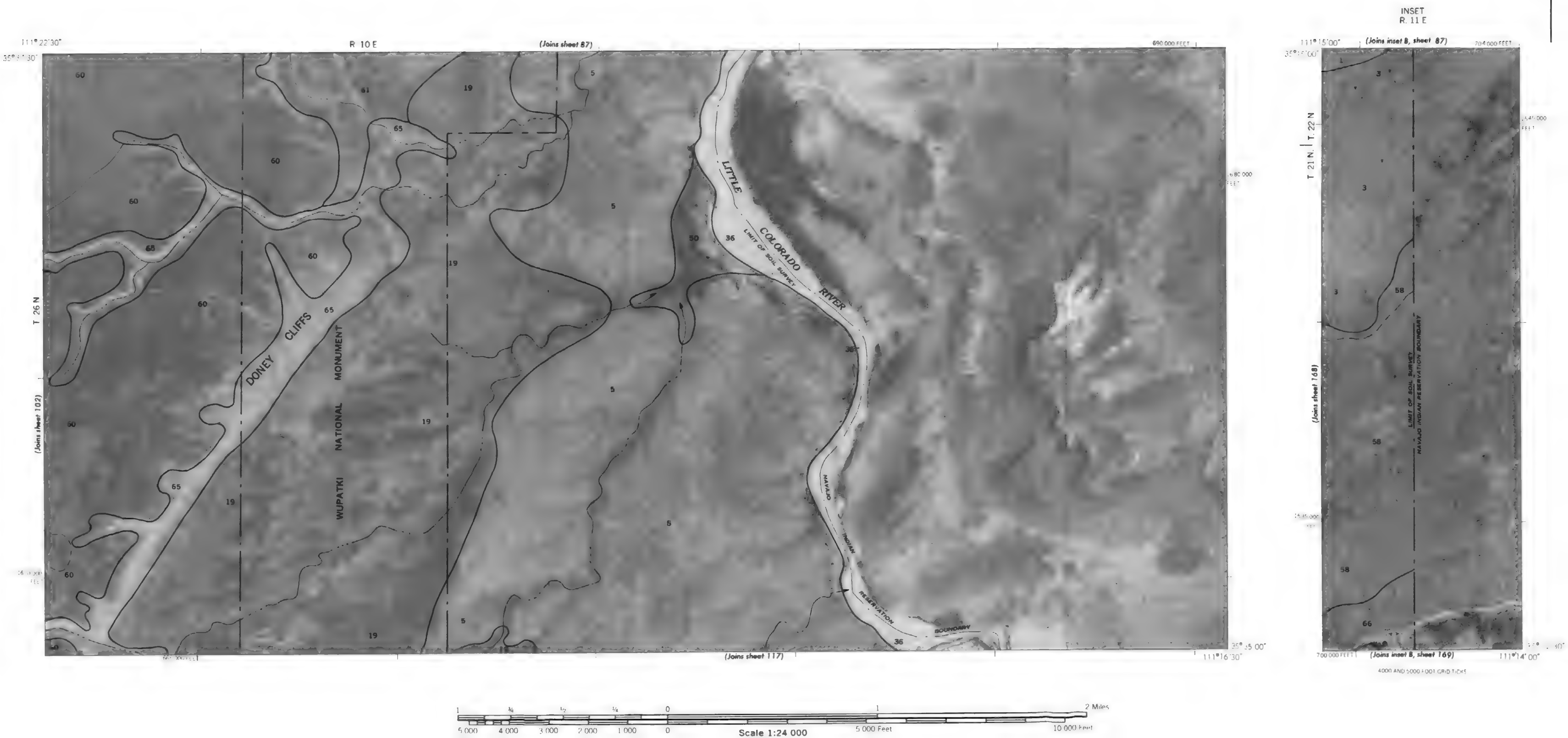
Scale 1:24 000

5,000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned

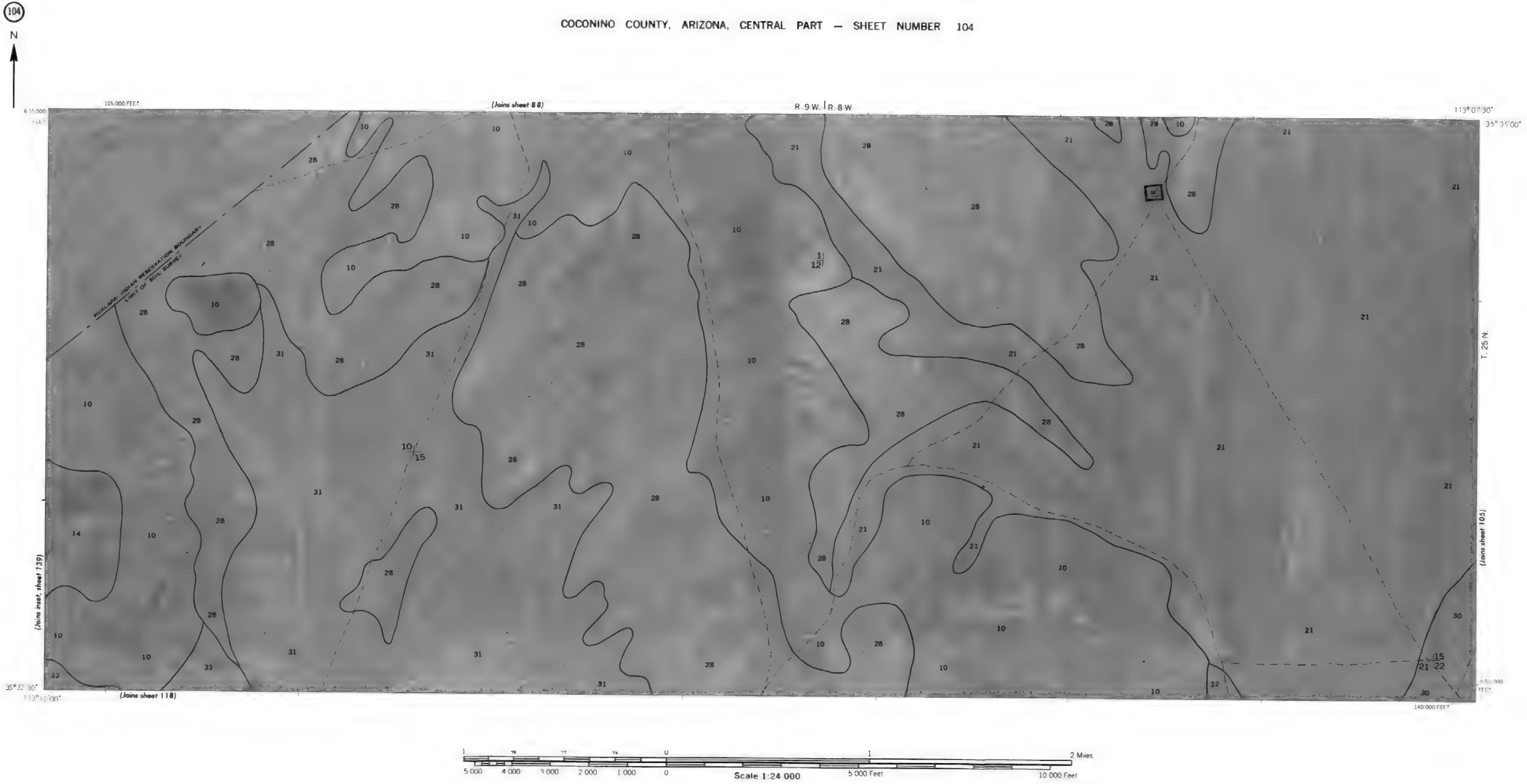
This map was compiled on 1972 and 1973 U.S. Department of The Interior Geological Survey orthophotography by the U.S. Department of Agriculture Soil Conservation Service and cooperating agencies

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 103

This map was compiled on 1972 and 1973 U.S. Department of The Interior, Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. 5 000 foot grid ticks based on state coordinate system. Land division corners if shown are approximately positioned.



COCONINO COUNTY, ARIZONA, CENTRAL PART — SHEET NUMBER 104



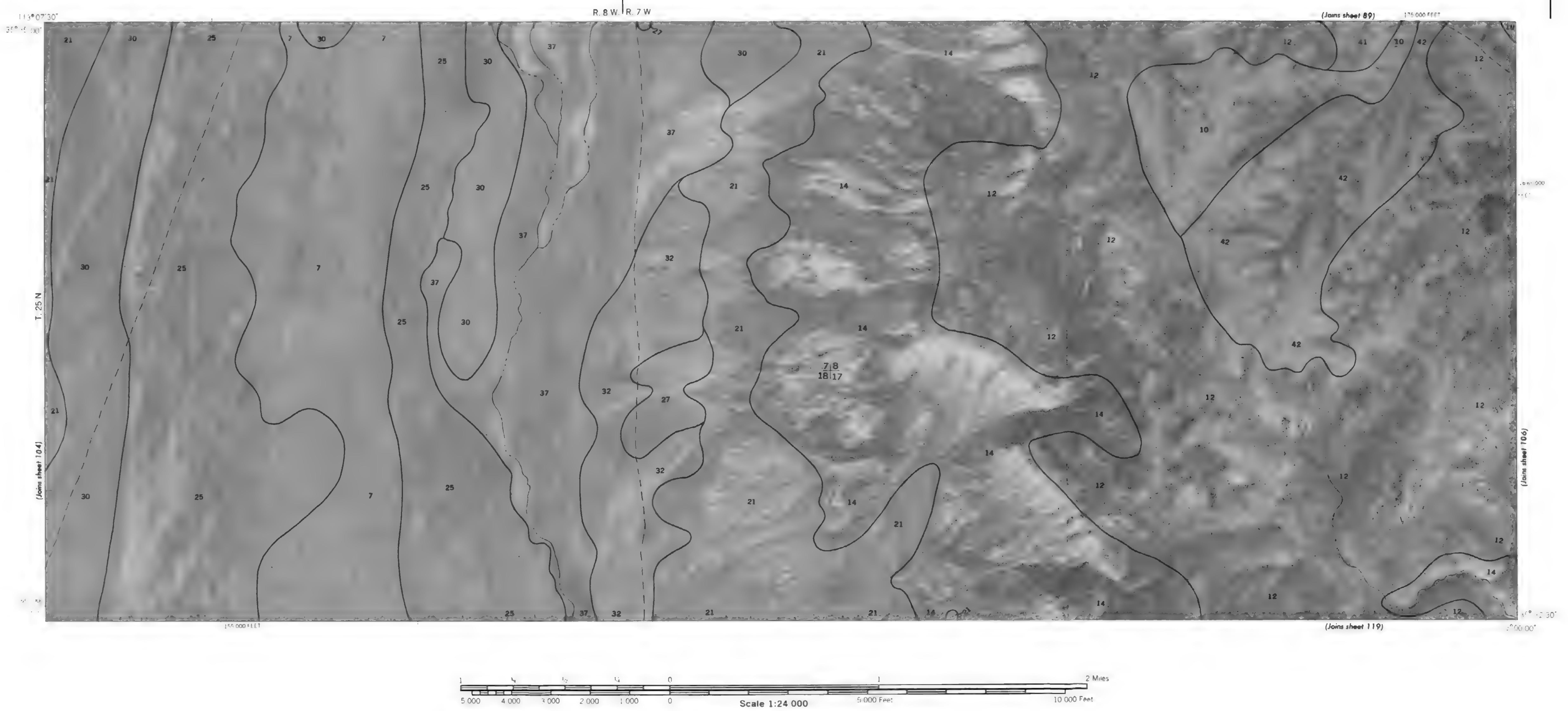
5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1972 and 1973 U.S. Department of the Interior, Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 104

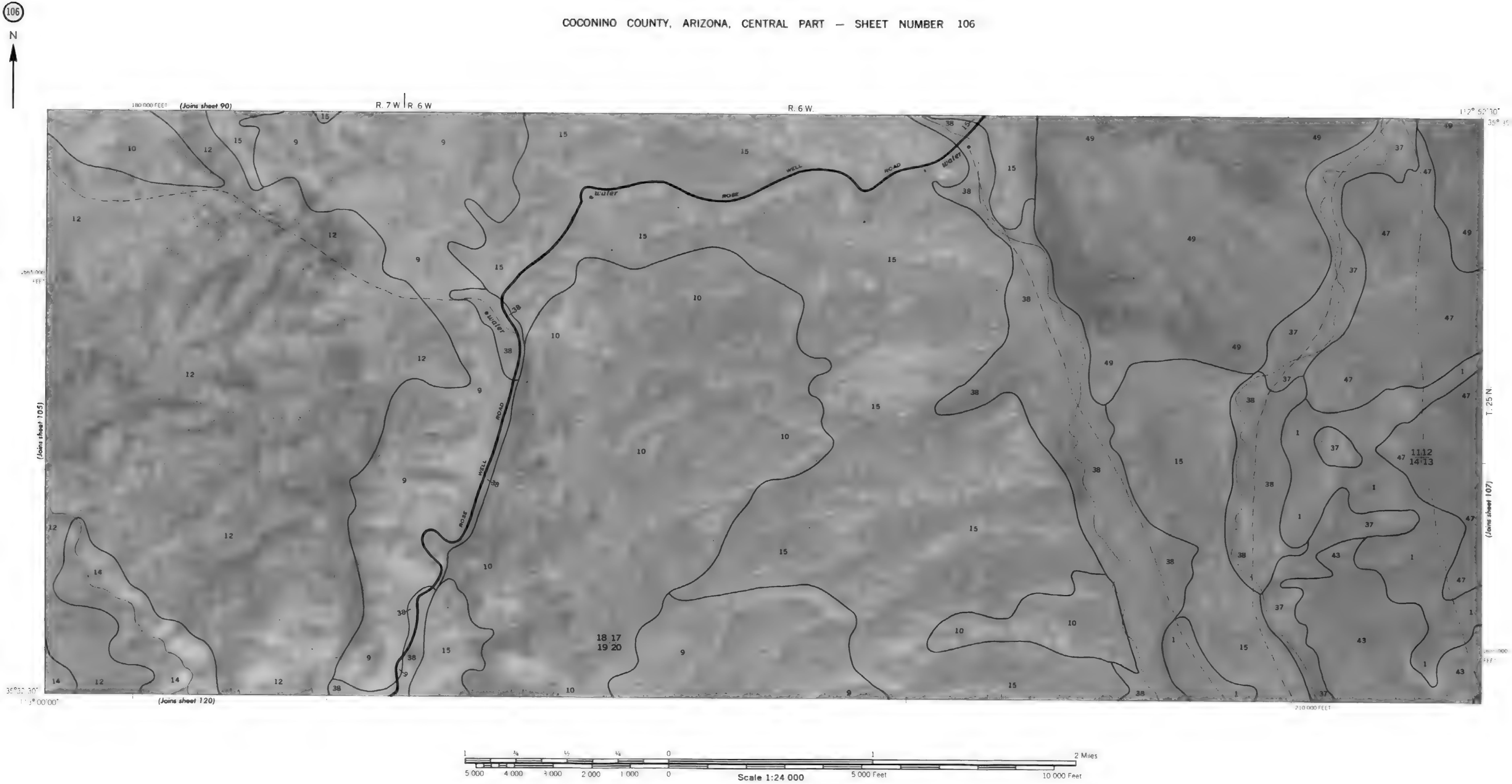
105

N



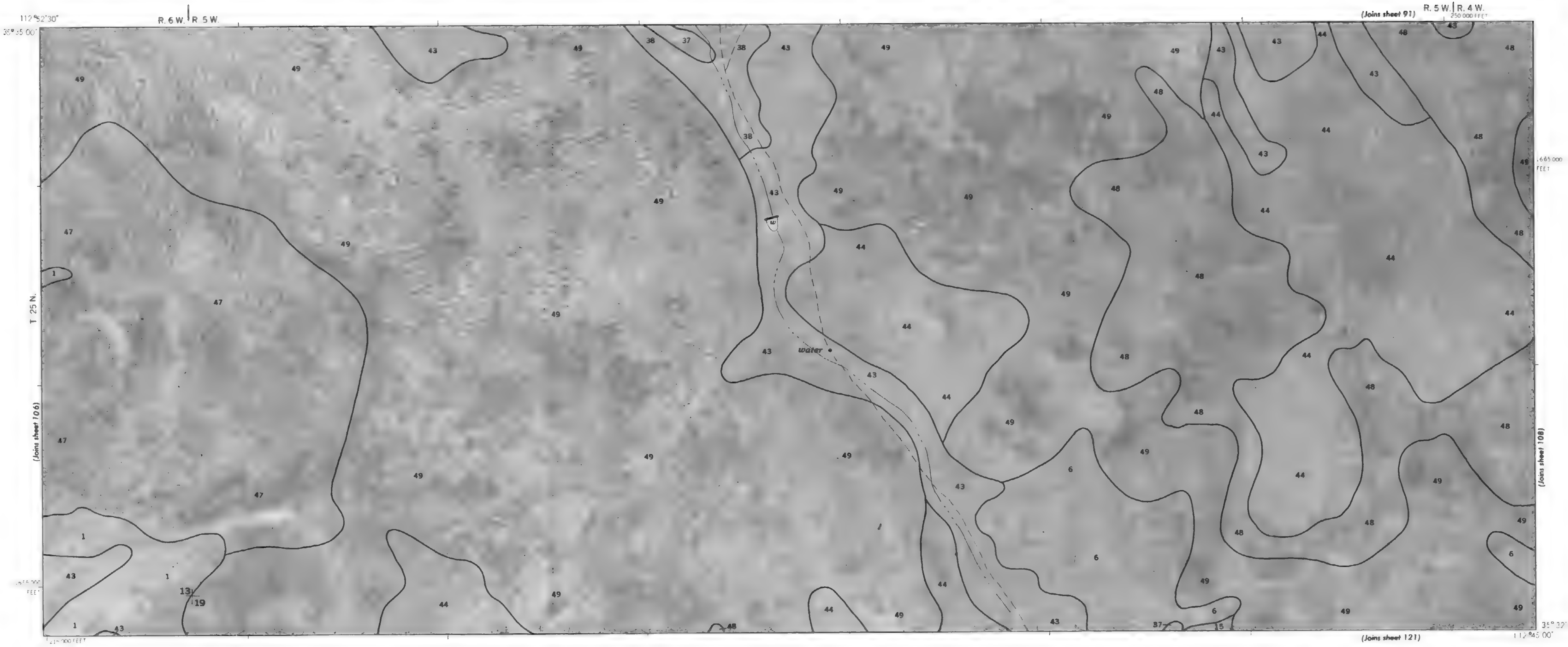
COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 105

This map was compiled on 1972 and 1973 U.S. Department of the Interior, Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.


106
N
(Joins sheet 90)
R. 7 W. R. 6 W.
R. 6 W.
(Joins sheet 105)
(Joins sheet 107)
(Joins sheet 120)
T. 25 N.
ROSE WELL ROAD
water
Scale 1:24 000
2 Miles
5 000 Feet
10 000 Feet
This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5 000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

107

N



Scale 1:24 000

1 ¾ ½ ¼ 0 1 2 Miles

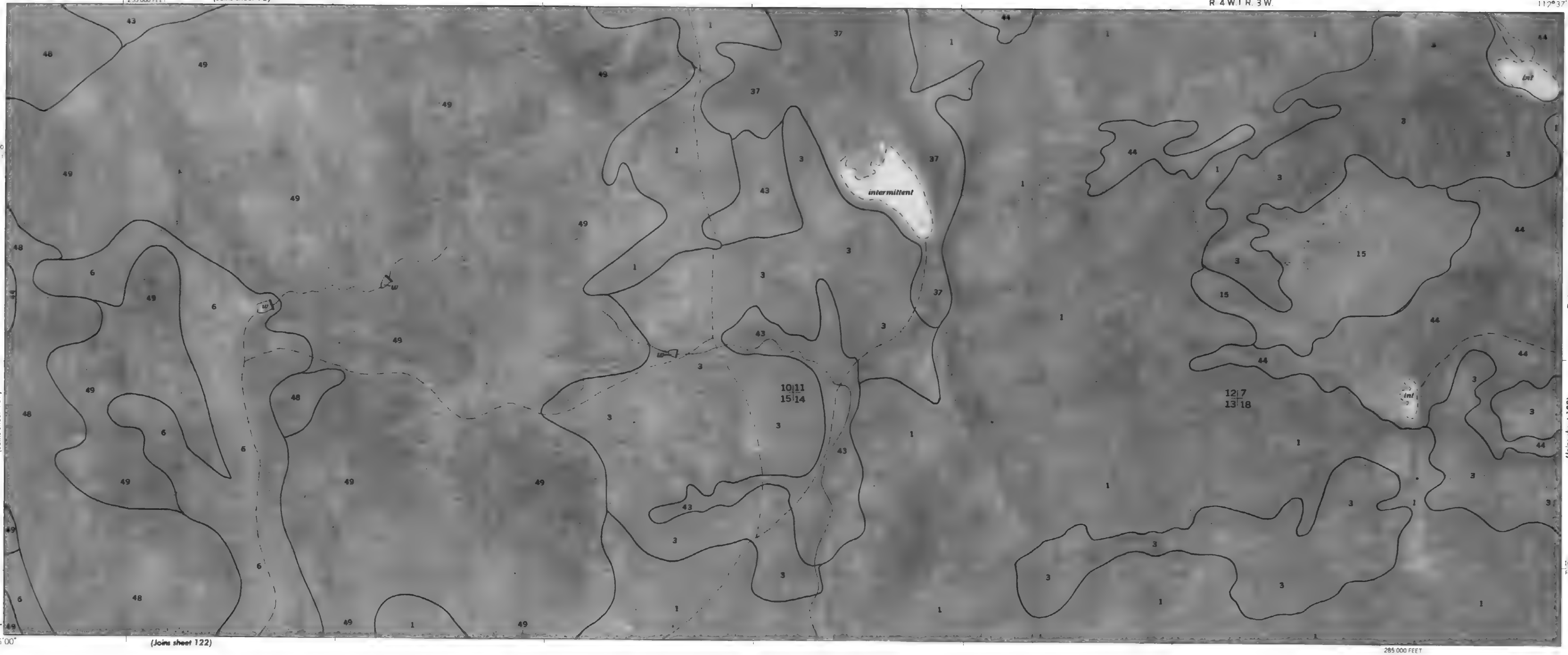
5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 107

This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotographs by the U.S. Department of Agriculture Soil Conservation Service and cooperating agencies. 5 000 foot grid ticks based on state coordinate system. Land division corners if shown are approximately positioned.

COCONINO COUNTY, ARIZONA, CENTRAL PART — SHEET NUMBER 108

N



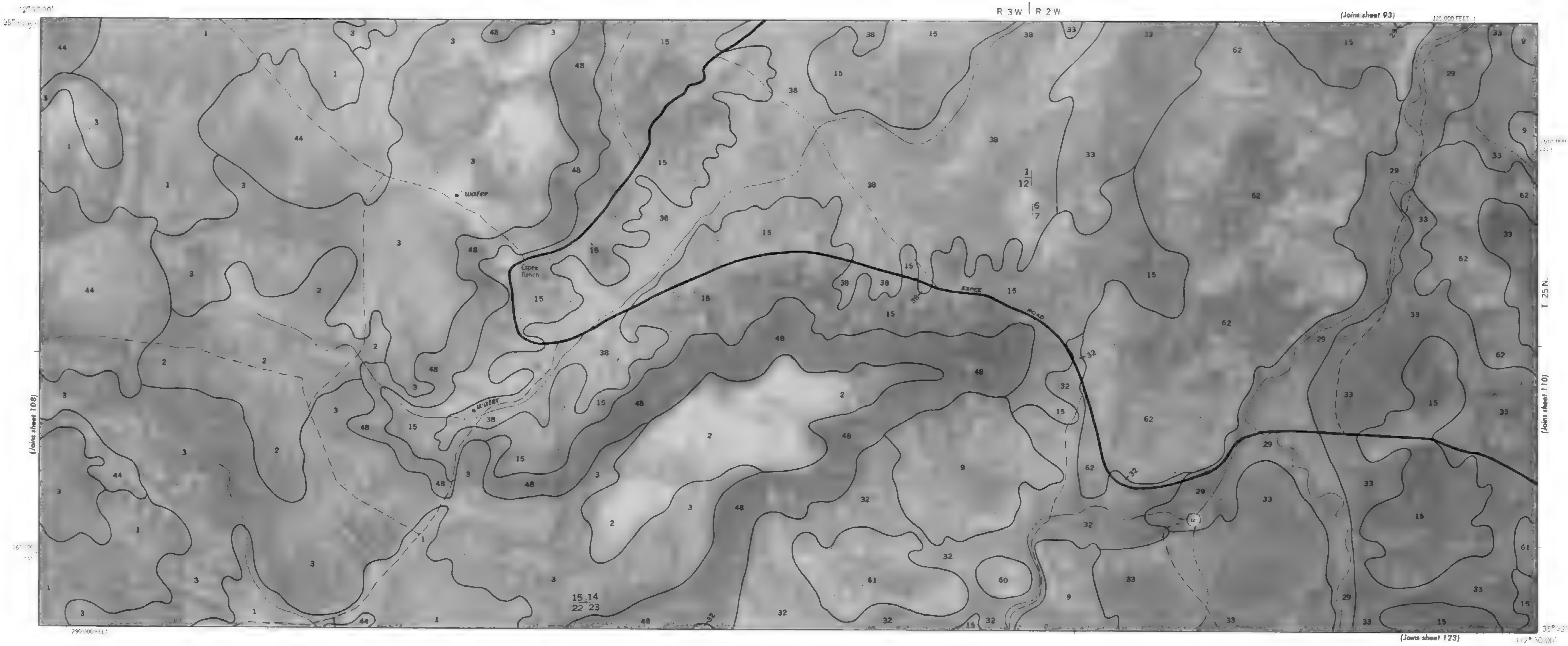
1 ¾ ½ ¼ 0 1 2 Miles
5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet
Scale 1:24 000

This map was compiled on 1972 and 1973 U.S. Department of The Interior Geological Survey orthophotography by the U.S. Department of Agriculture Soil Conservation Service and cooperating agencies
5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 108

N

This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotographs by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. 5,000-foot grid ticks based on state coordinate system. Land division corners if shown are approximately positioned.

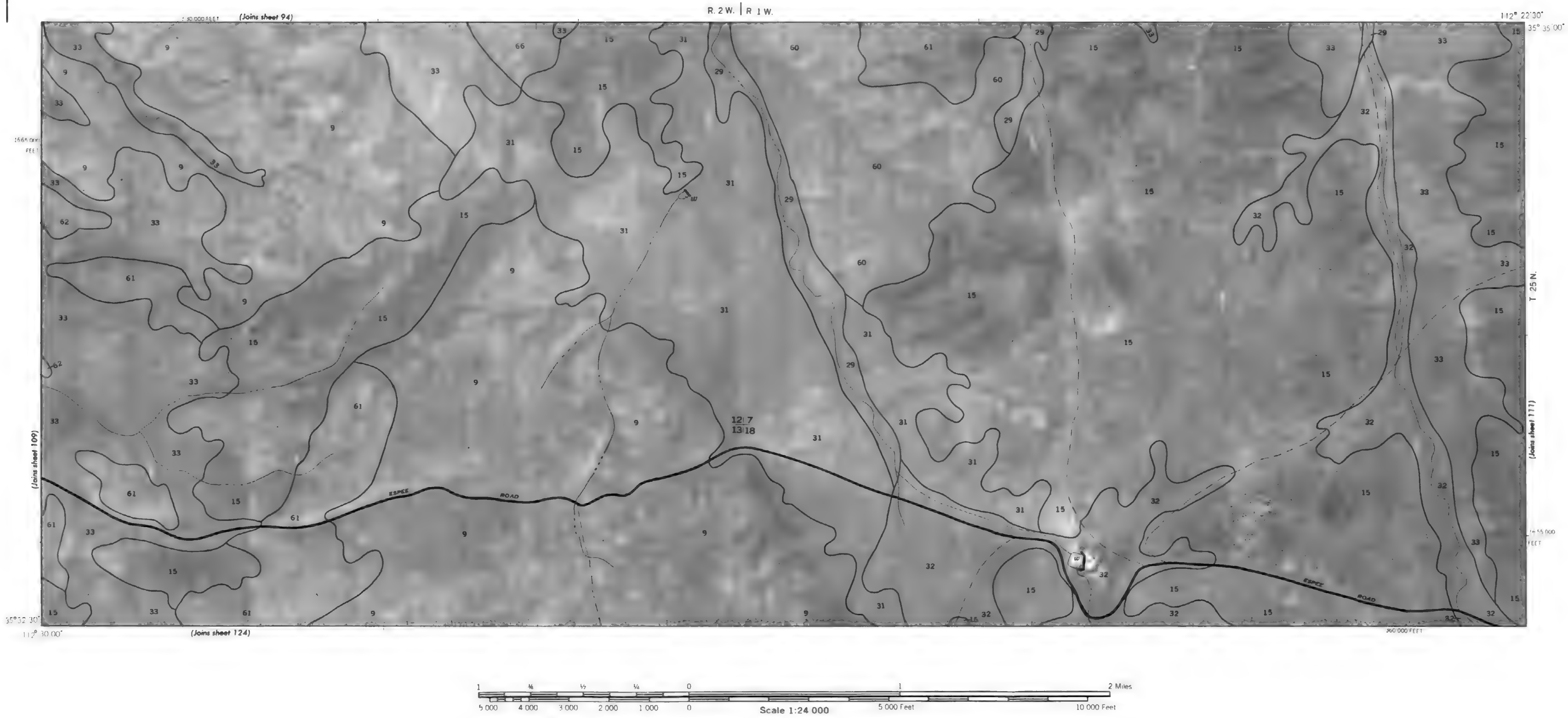


Scale 1:24 000

1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

COCONINO COUNTY, ARIZONA, CENTRAL PART — SHEET NUMBER 110



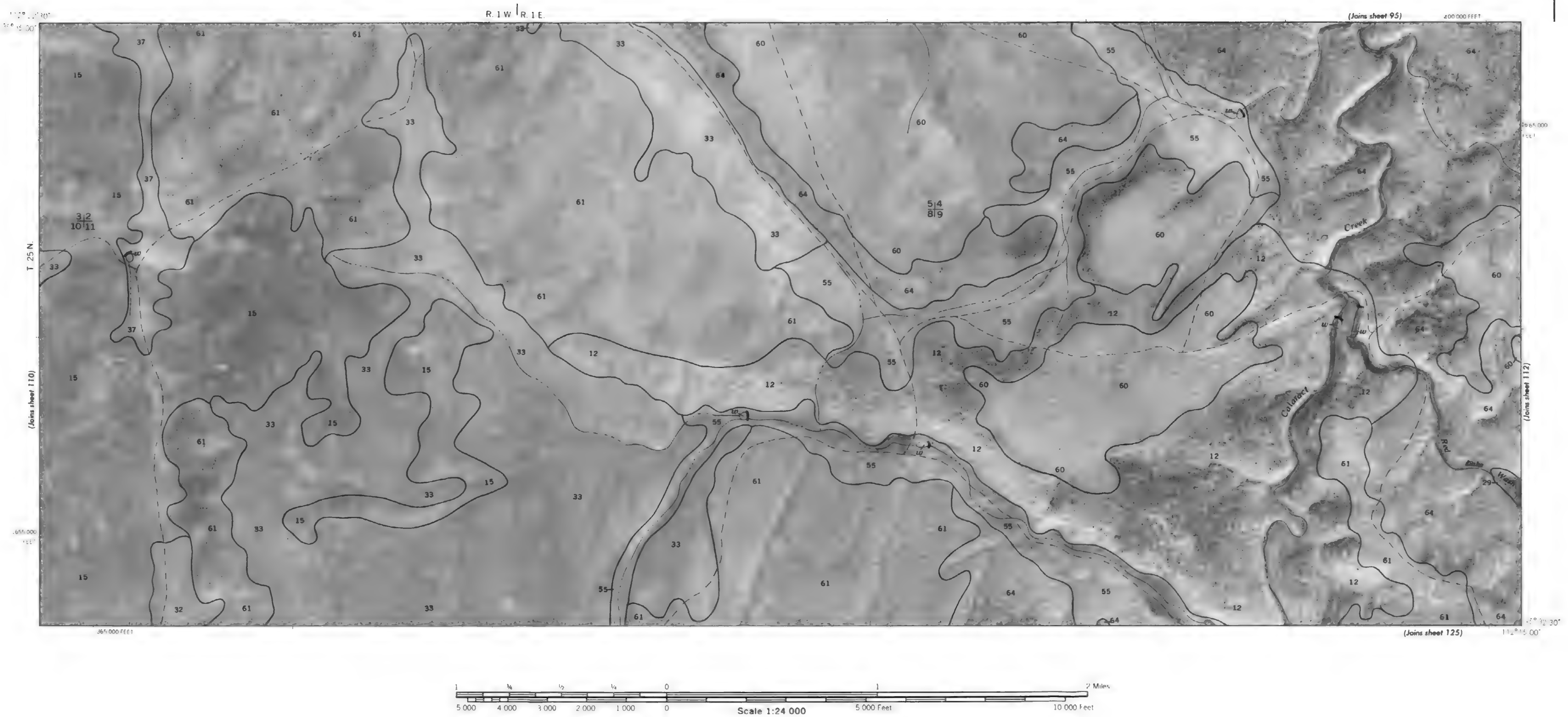
5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotographs by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

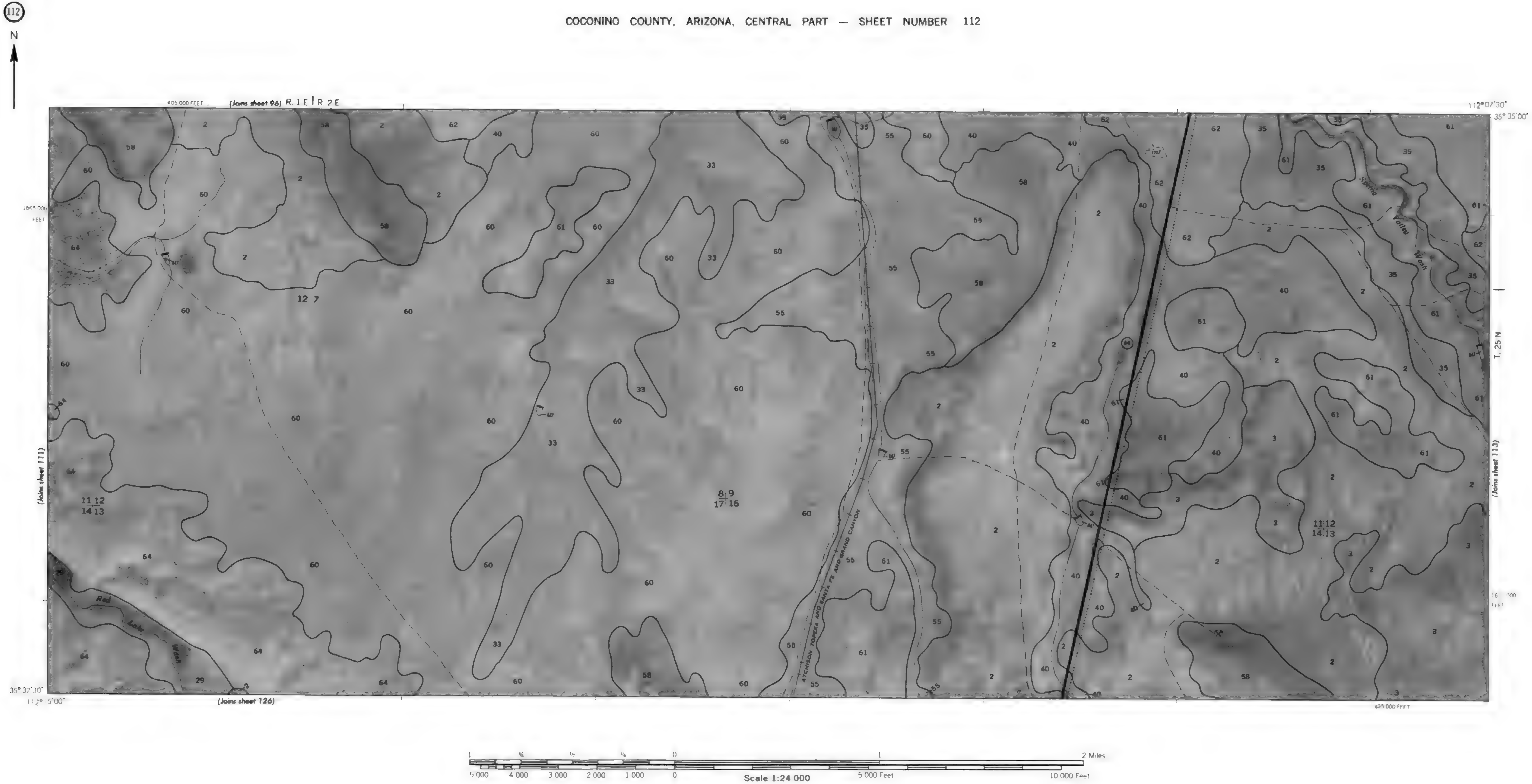
COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 110

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 111

This map was compiled on 1972 and 1973 U.S. Department of The Interior Geological Survey orthophotography by the U.S. Department of Agriculture Soil Conservation Service and cooperating agencies.
5,000 foot grid ticks based on state coordinate system. Land division corners if shown are approximately positioned.



Scale 1:24 000



5 000-foot grid ticks based on state coordinate system. Land division corners if shown are approximately positioned.

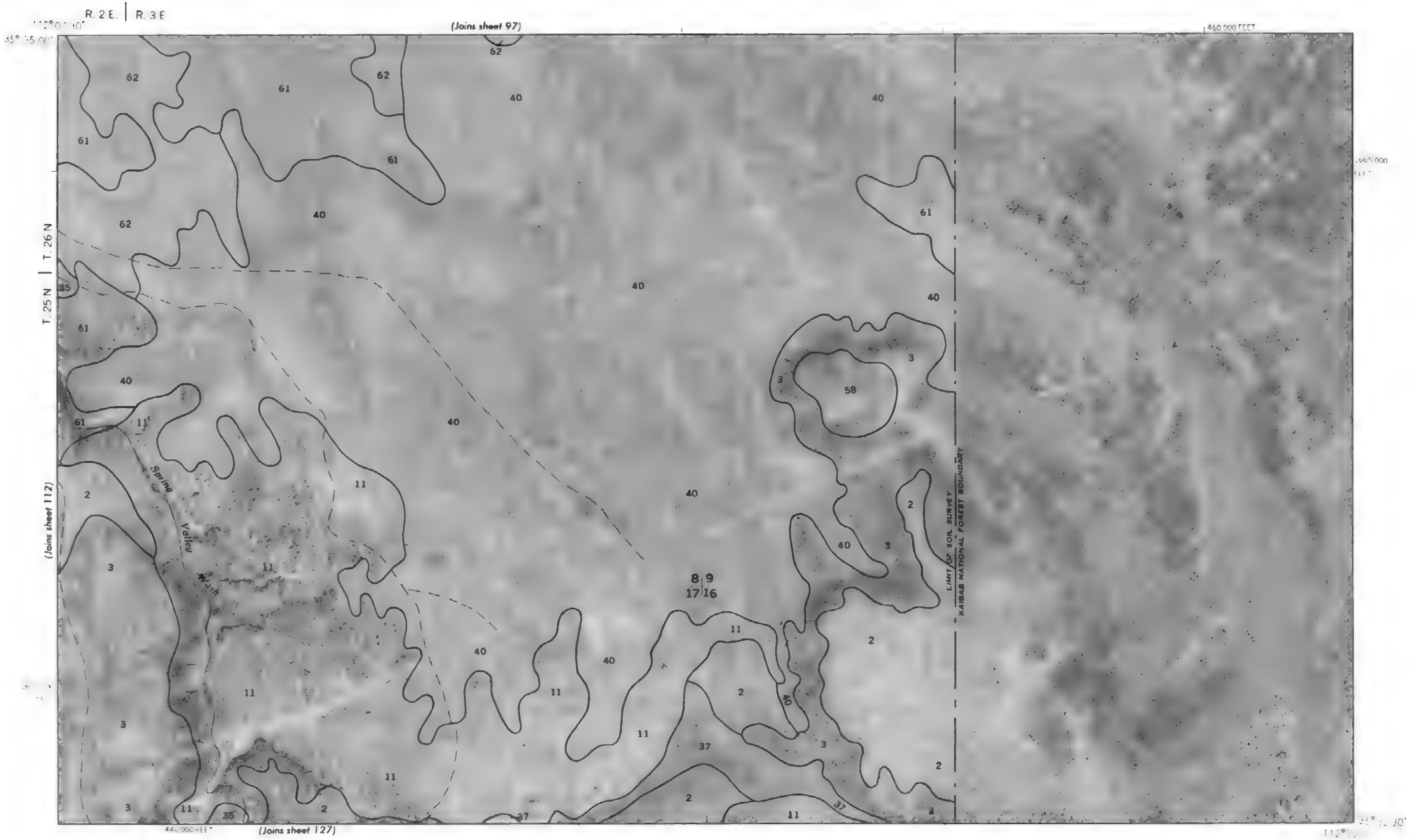
This map was compiled on 1972 and 1973 U.S. Department of The Interior Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 112

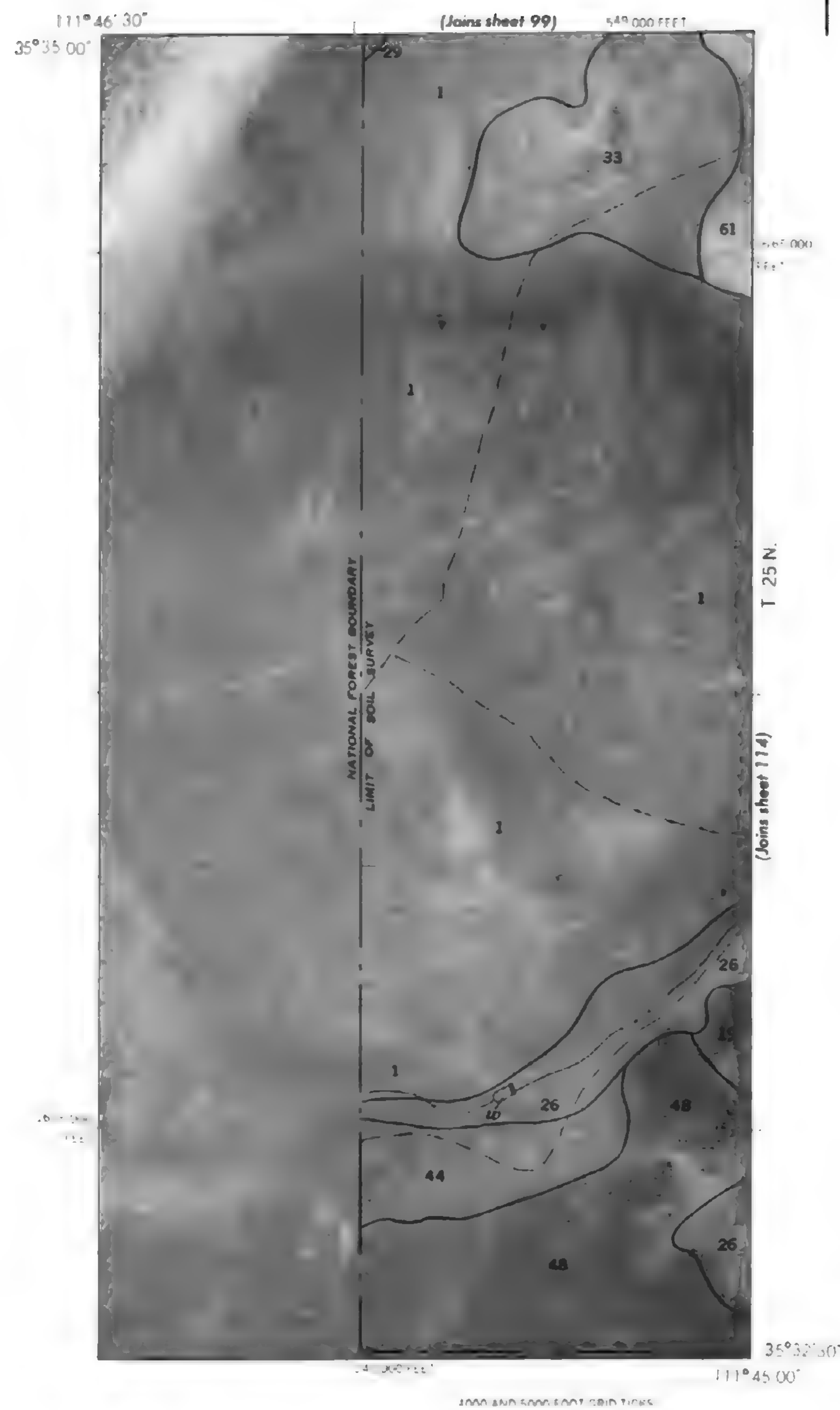
113

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 113

This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotographs by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.



INSET



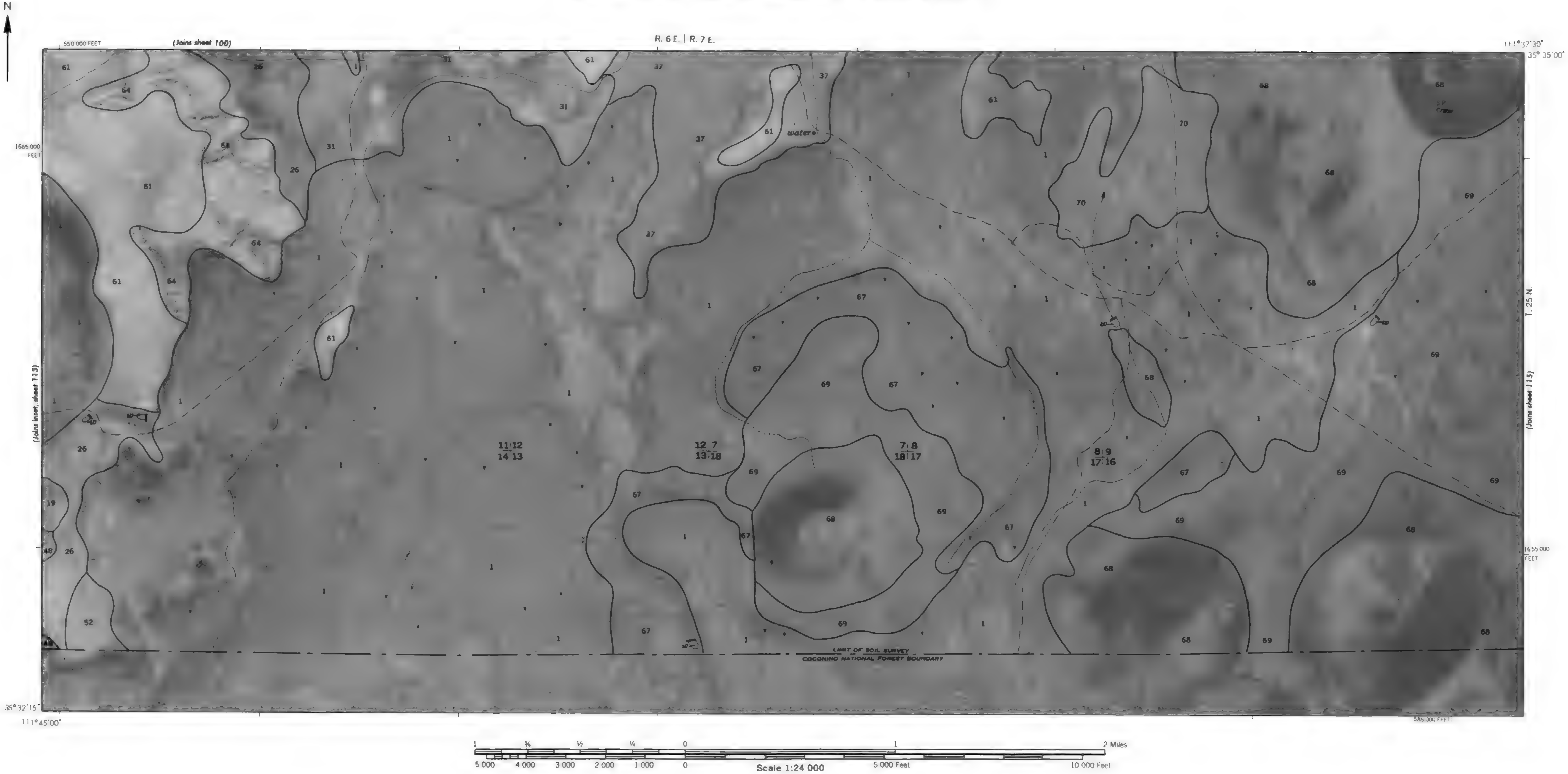
N

Scale 1:24 000

1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

COCONINO COUNTY, ARIZONA, CENTRAL PART — SHEET NUMBER 114



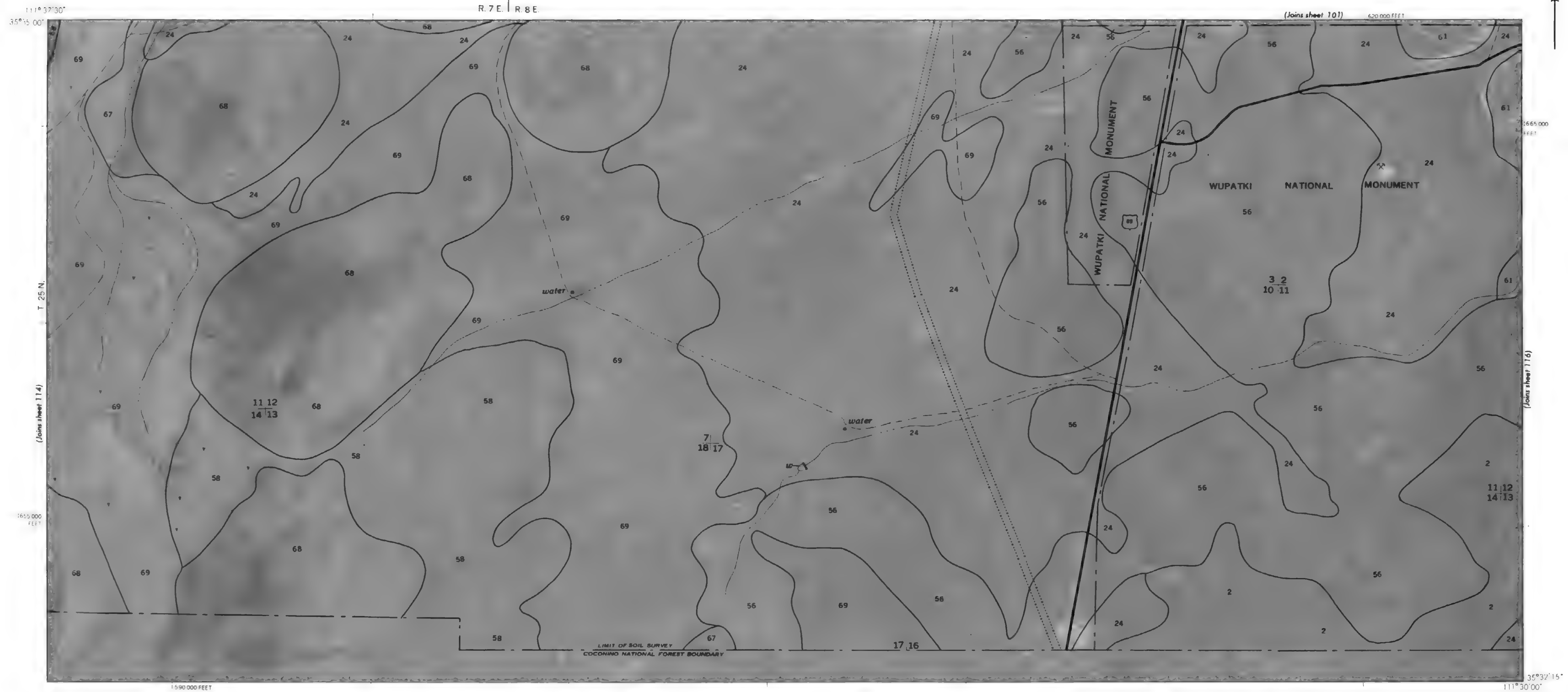
This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies

5 000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 114

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 115

This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. 5 000 foot grid ticks based on state coordinate system. Land division corners if shown are approximately positioned.

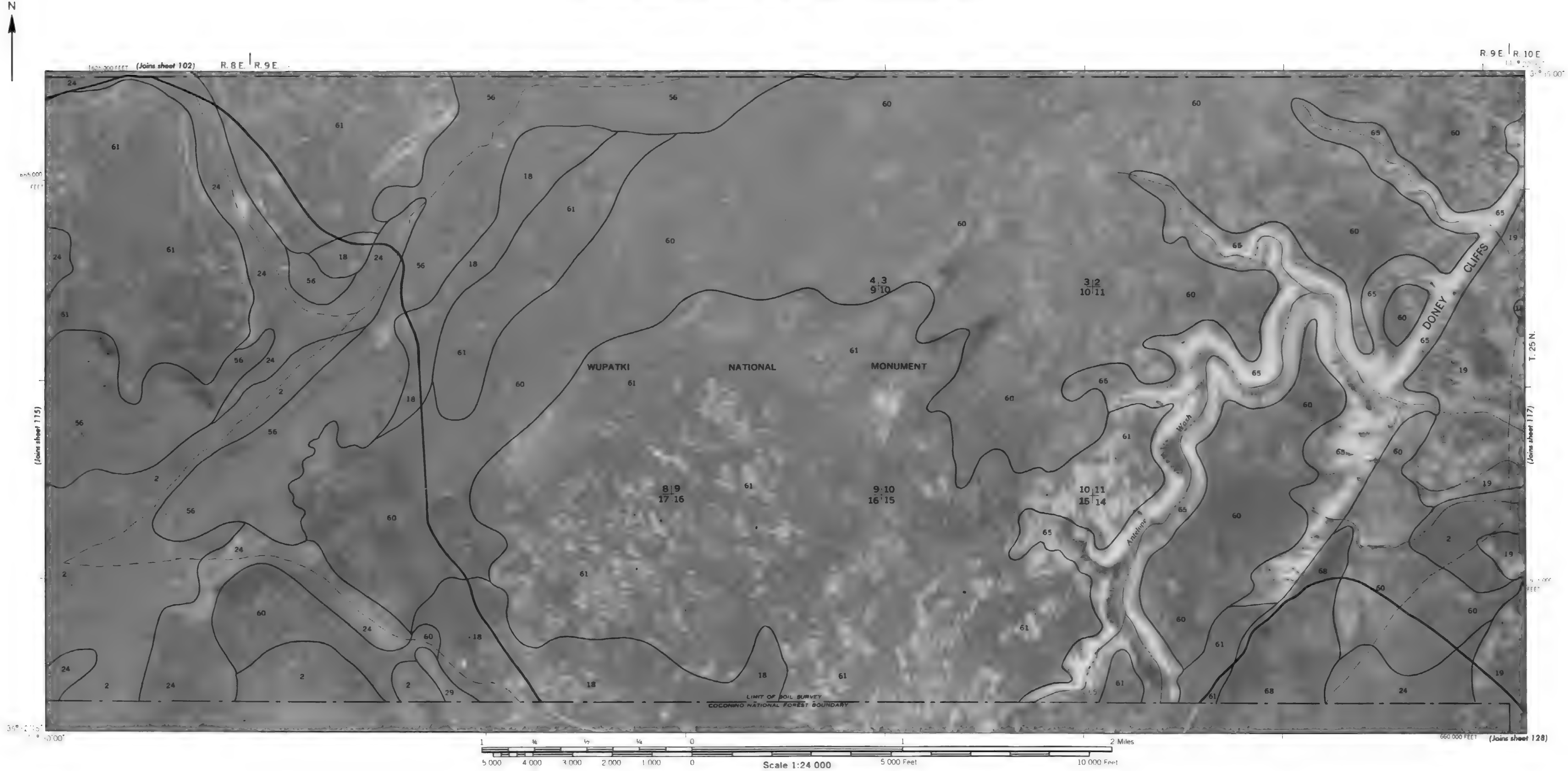


1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

COCONINO COUNTY, ARIZONA, CENTRAL PART — SHEET NUMBER 116



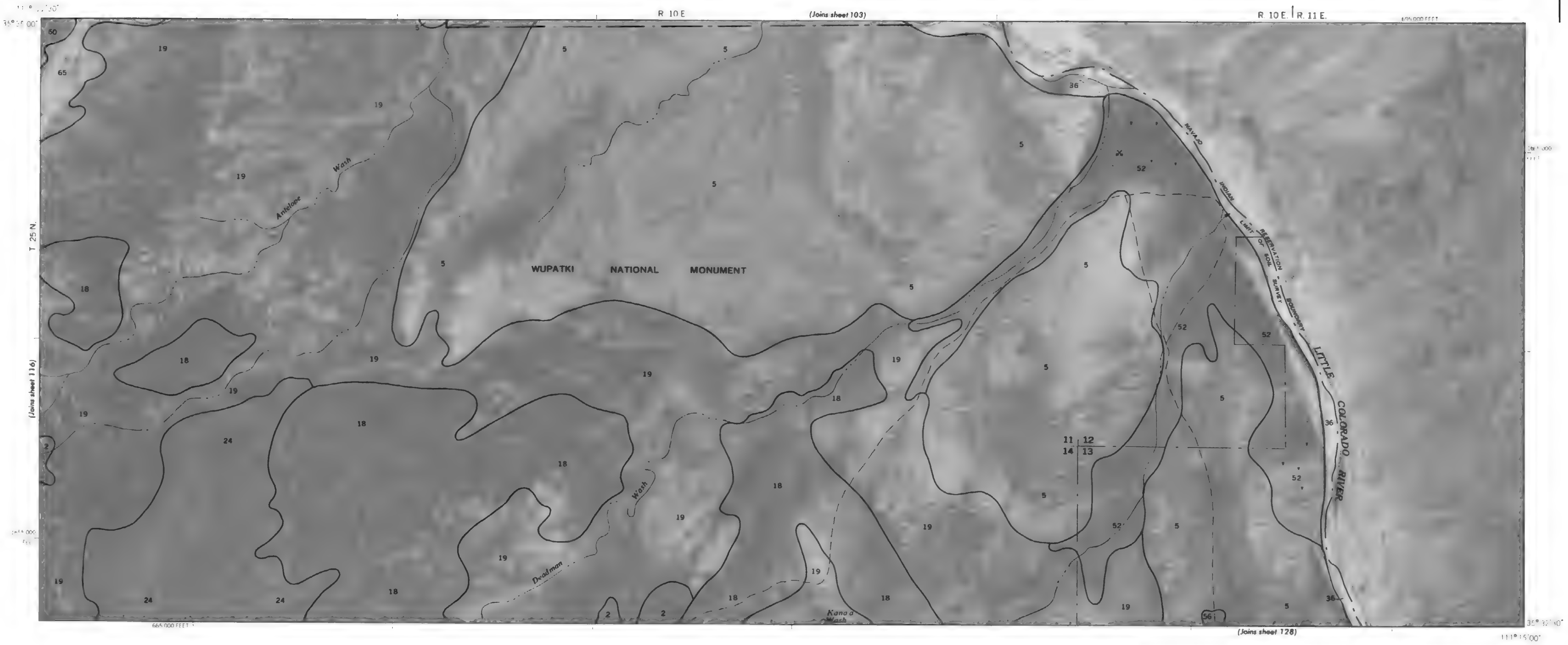
5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.
This map was compiled on 1972 and 1973 U S Department of the Interior Geological Survey orthophotography by the U S Department of Agriculture Soil Conservation Service and cooperating agencies.

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 116

N

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 117

This map was compiled on 1972 and 1973 U.S. Department of The Interior Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. 5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

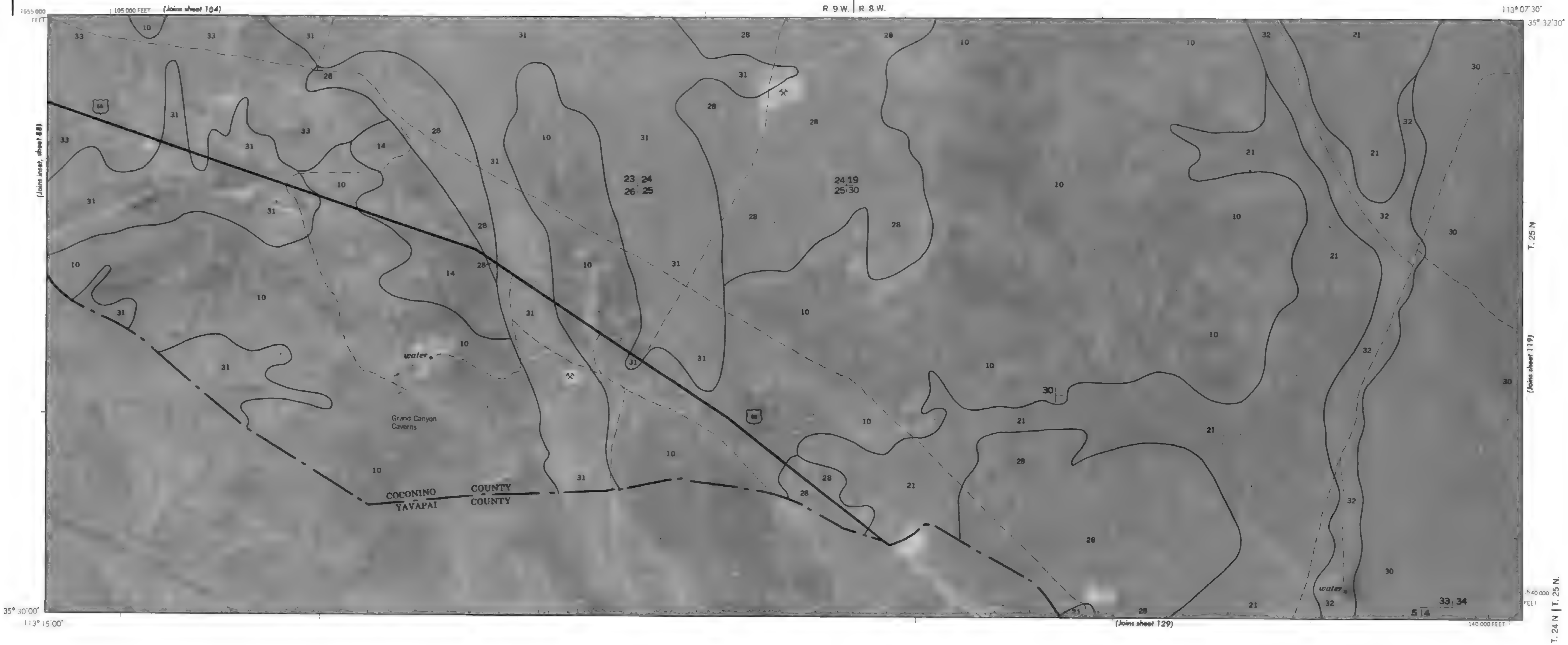


1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

COCONINO COUNTY, ARIZONA, CENTRAL PART — SHEET NUMBER 118



1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

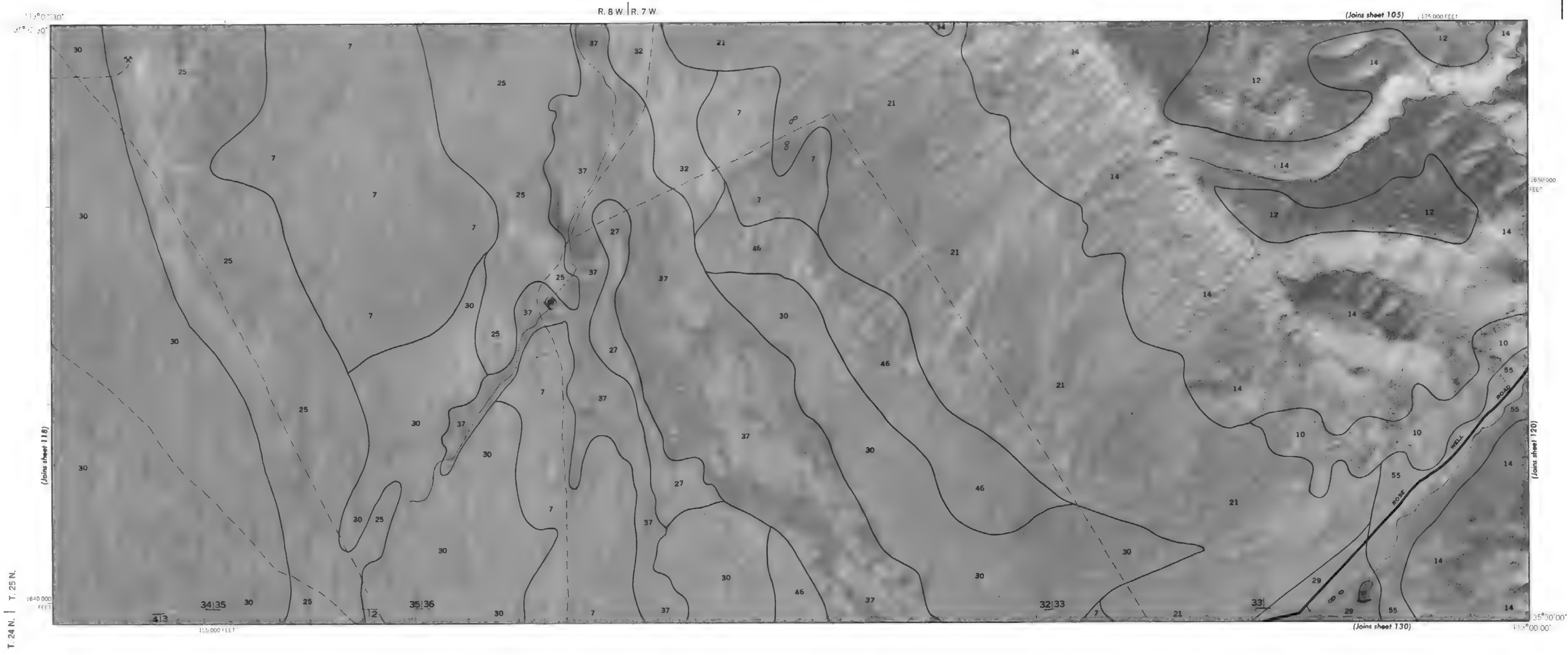
COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 118

119

N

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 119

This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotography by the U.S. Department of Agriculture Soil Conservation Service and cooperating agencies.
5 000 foot grid ticks based on state coordinate system. Land division corners if shown are approximately positioned.

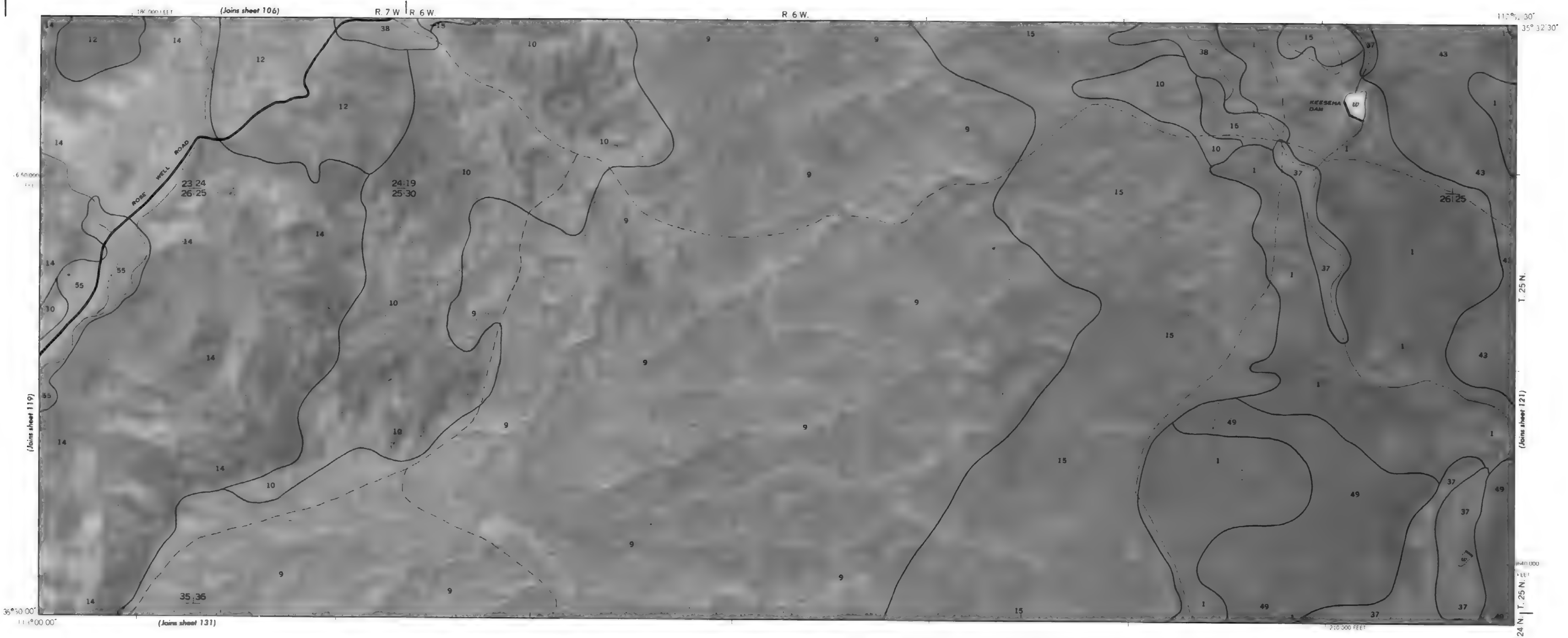


Scale 1:24 000

1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

COCONINO COUNTY, ARIZONA, CENTRAL PART — SHEET NUMBER 120



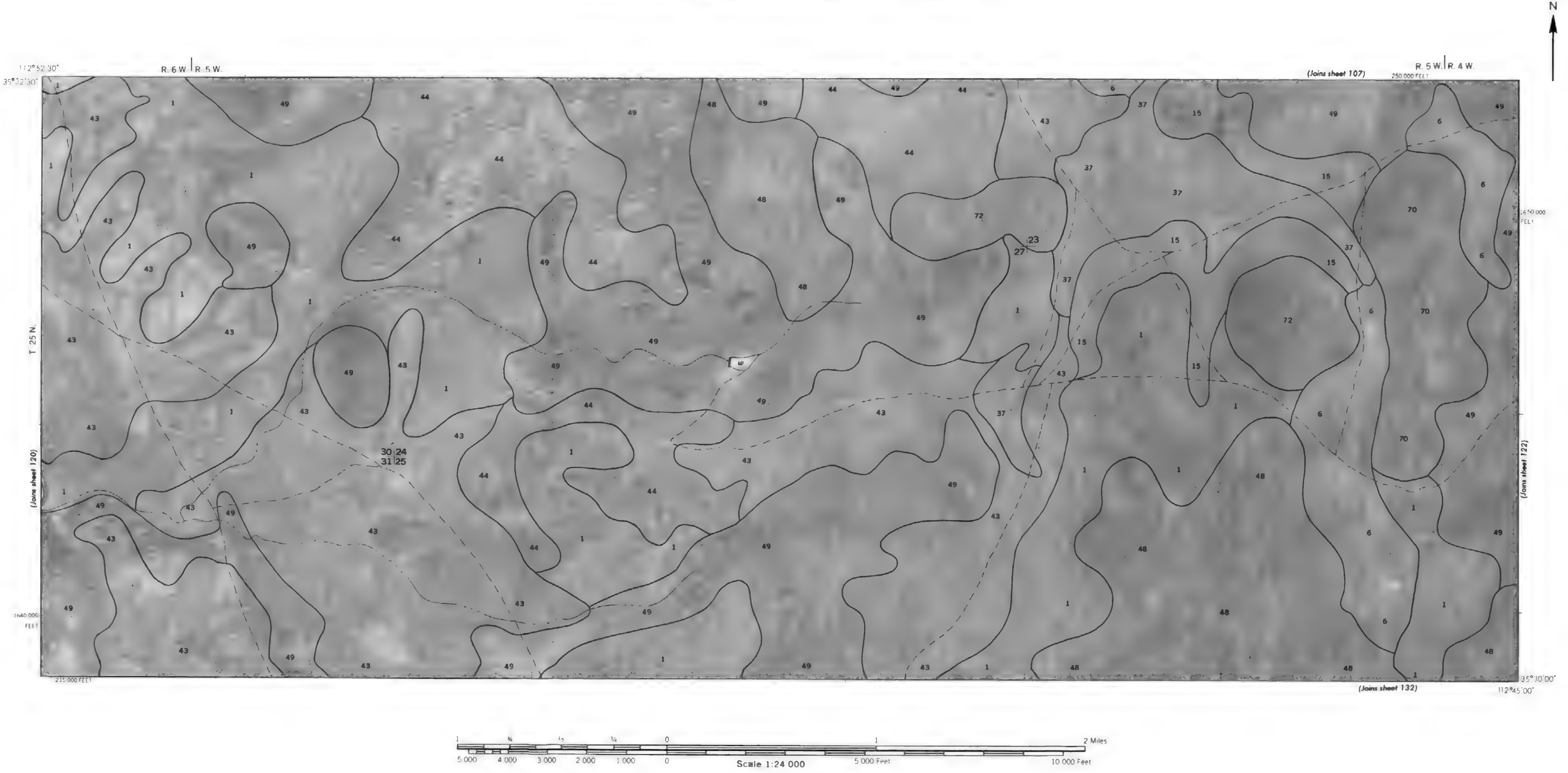
1 ¾ ½ ¼ 0 1 2 Miles

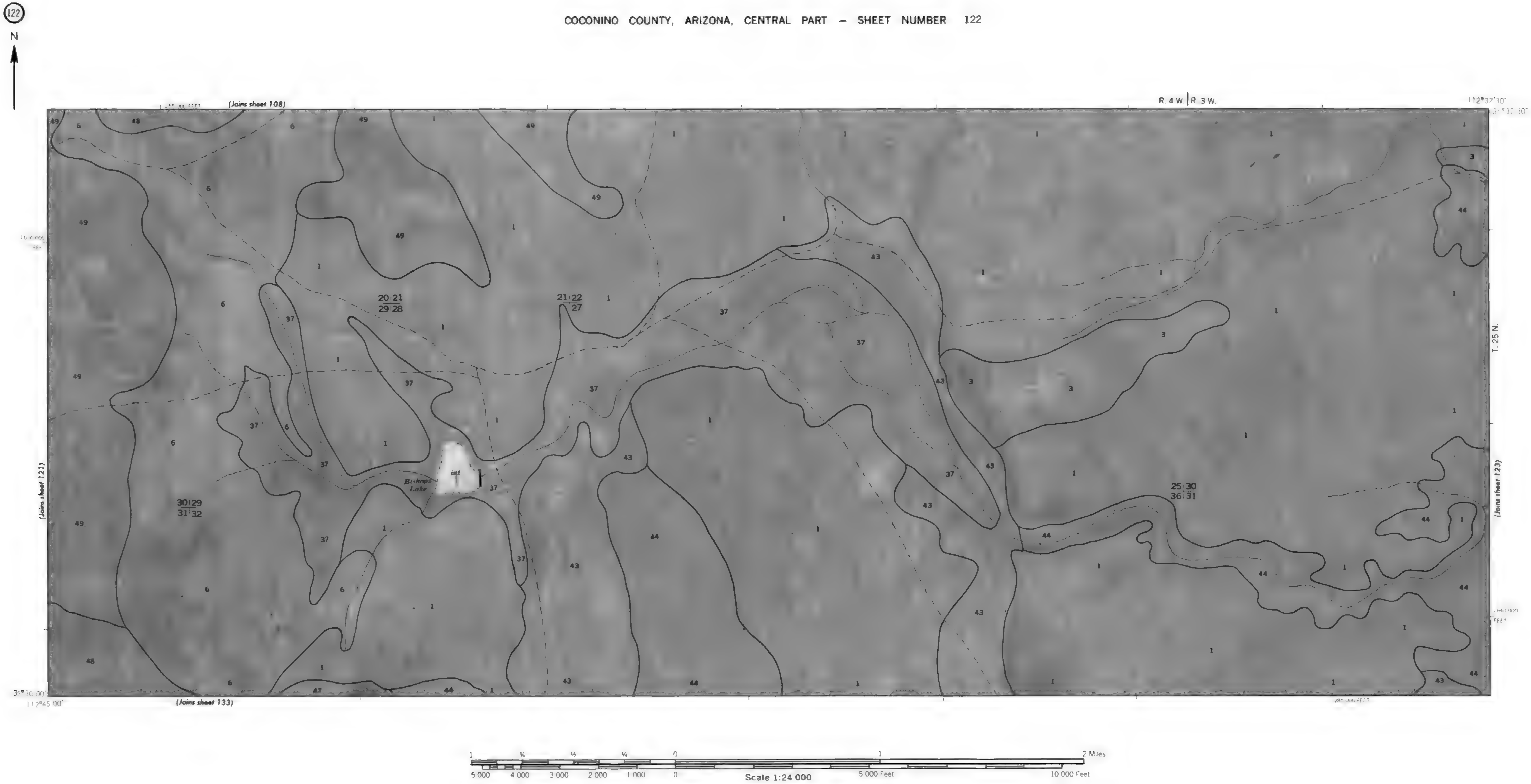
5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 120

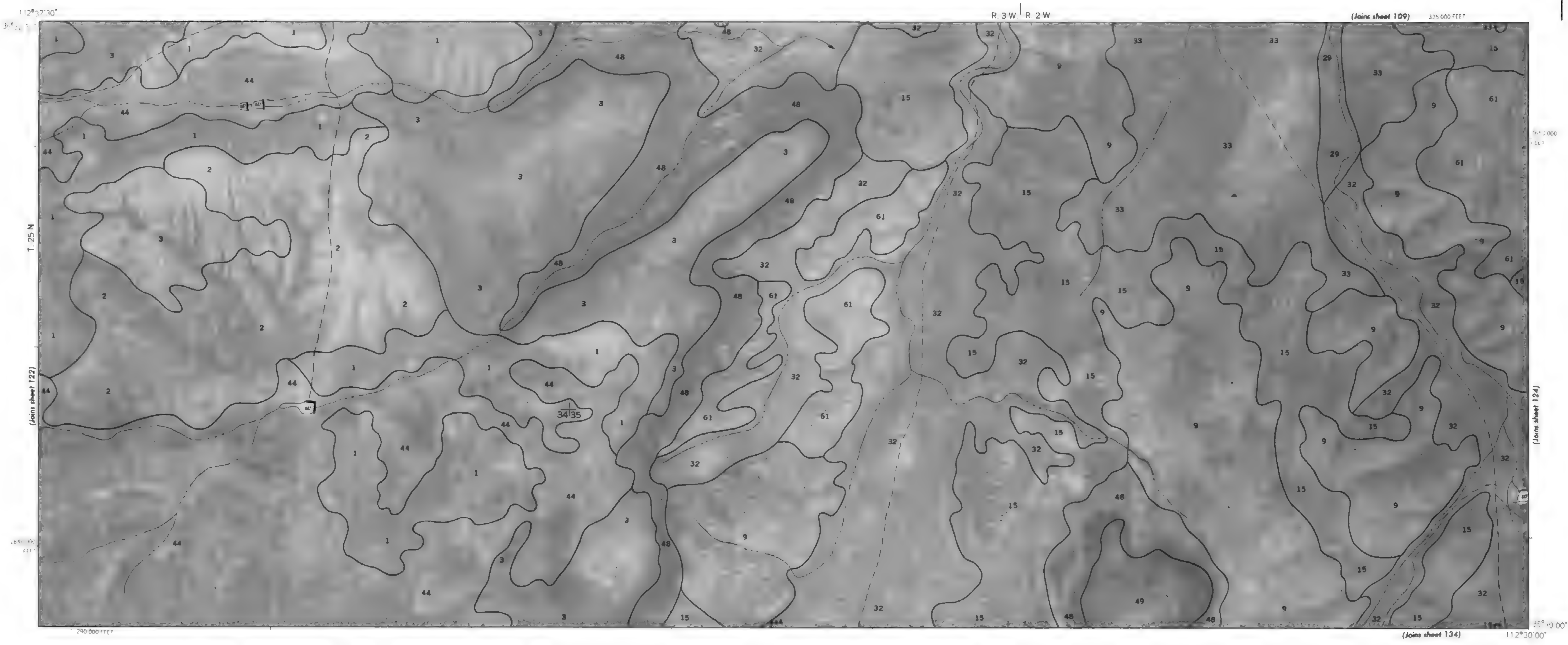
This map was compiled on 1972 and 1973 U.S. Department of the Interior, Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.





5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.
This map was compiled on 1972 and 1973 U.S. Department of the Interior, Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

N



1 ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

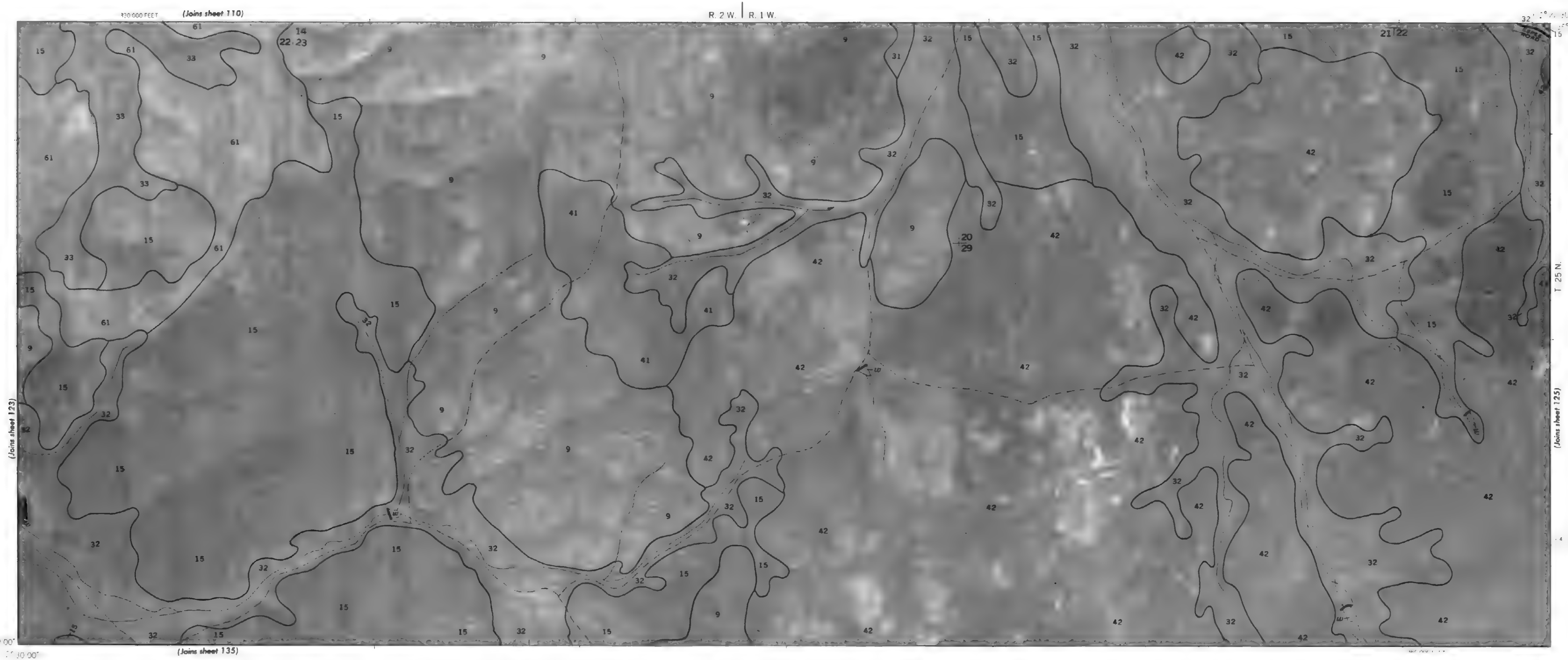
Scale 1:24 000

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 123

This map was compiled on 1972 and 1973 U.S. Department of The Interior Geological Survey orthophotographs by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

COCONINO COUNTY, ARIZONA, CENTRAL PART — SHEET NUMBER 124

N



1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

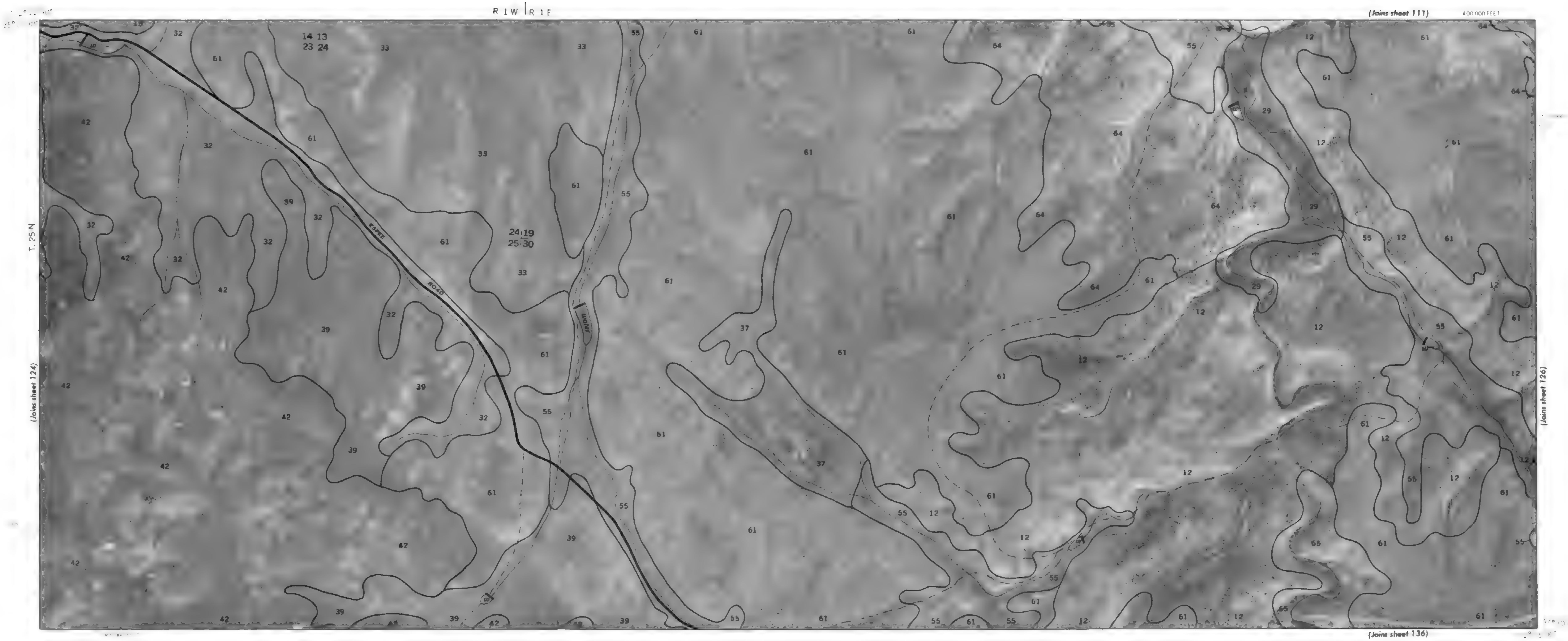
This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 124

125

N

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 125

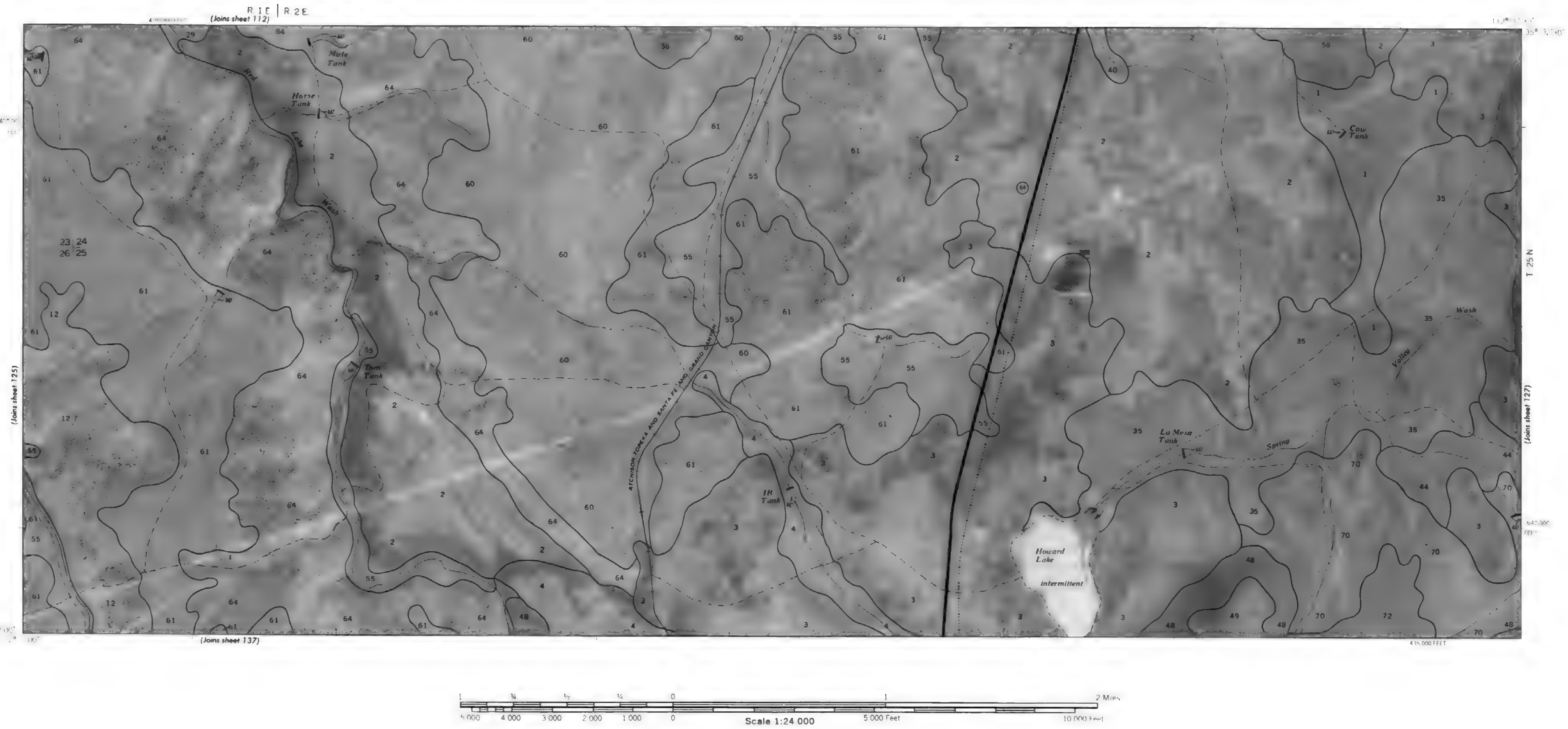


Scale 1:24 000

1 Miles 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

COCONINO COUNTY, ARIZONA, CENTRAL PART — SHEET NUMBER 126



5,000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1977 and 1973 U.S. Department of the Interior Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

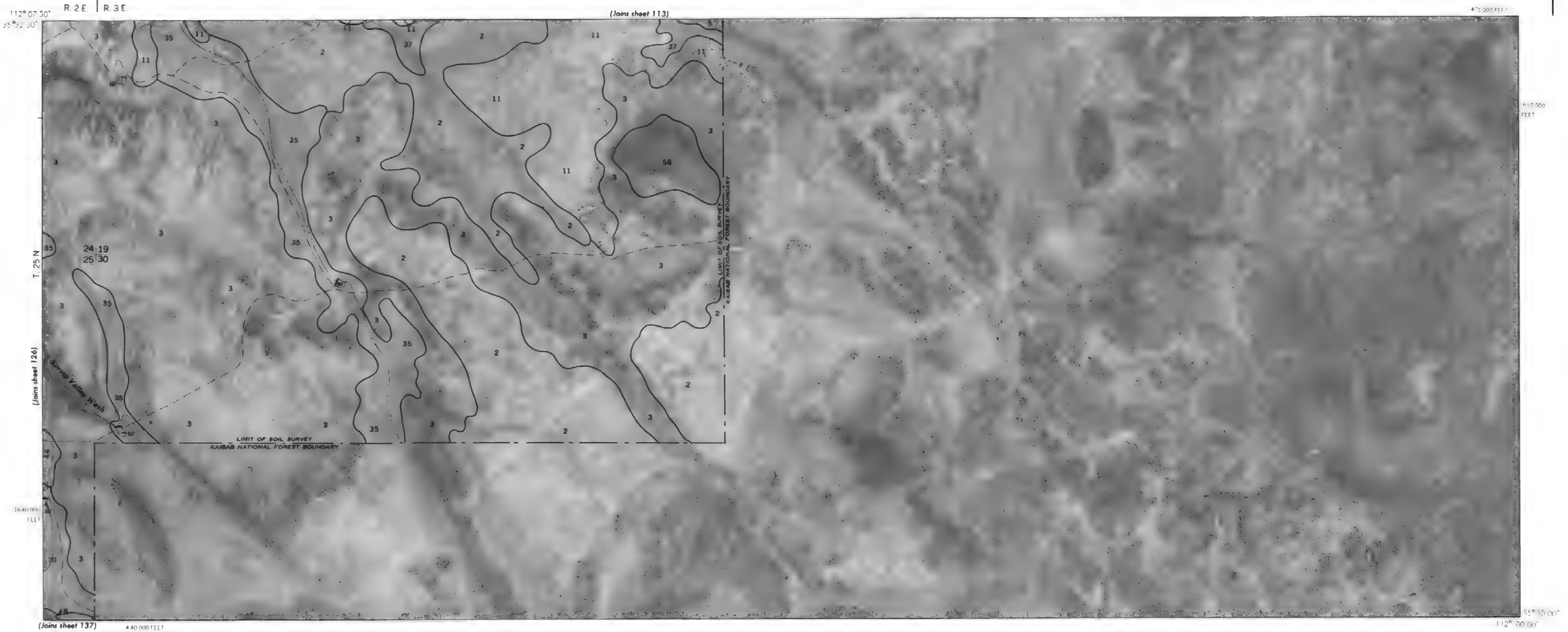
COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 126

127

N

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 127

This map was compiled on 1972 and 1973 U.S. Department of the Interior, Geological Survey orthophotographs by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. 5 000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.



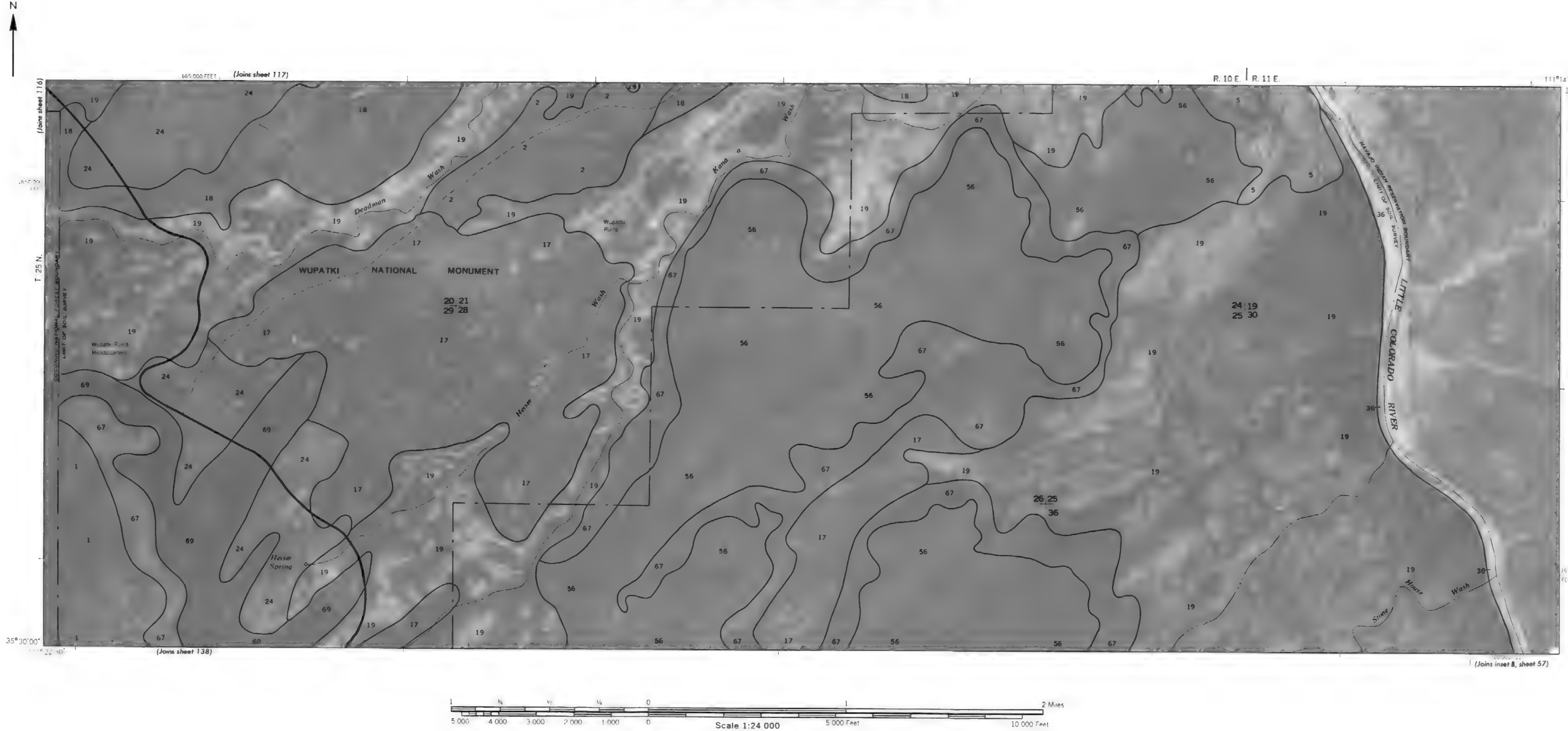
1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

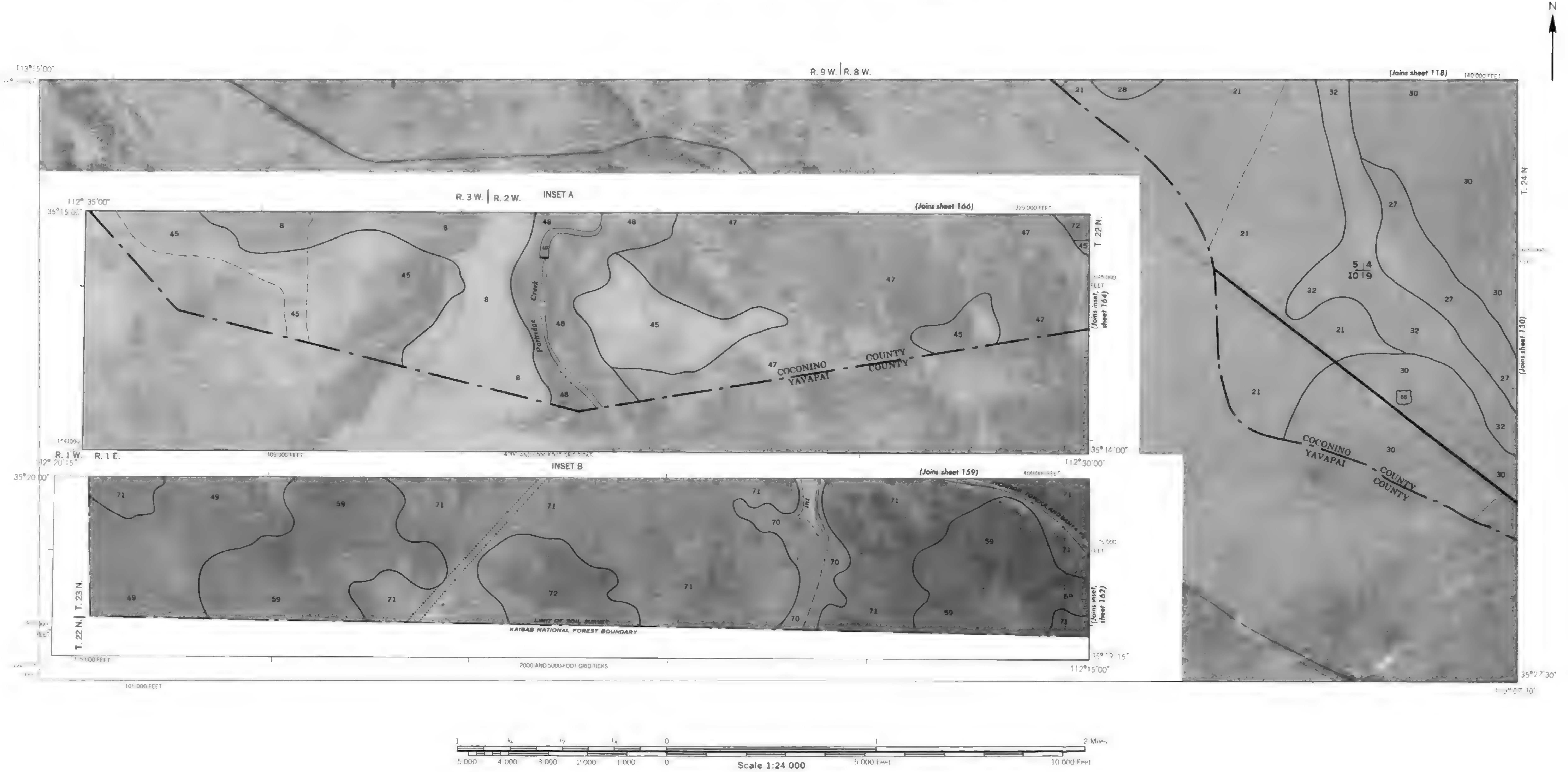
Scale 1:24 000

(128)

COCONINO COUNTY, ARIZONA, CENTRAL PART — SHEET NUMBER 128



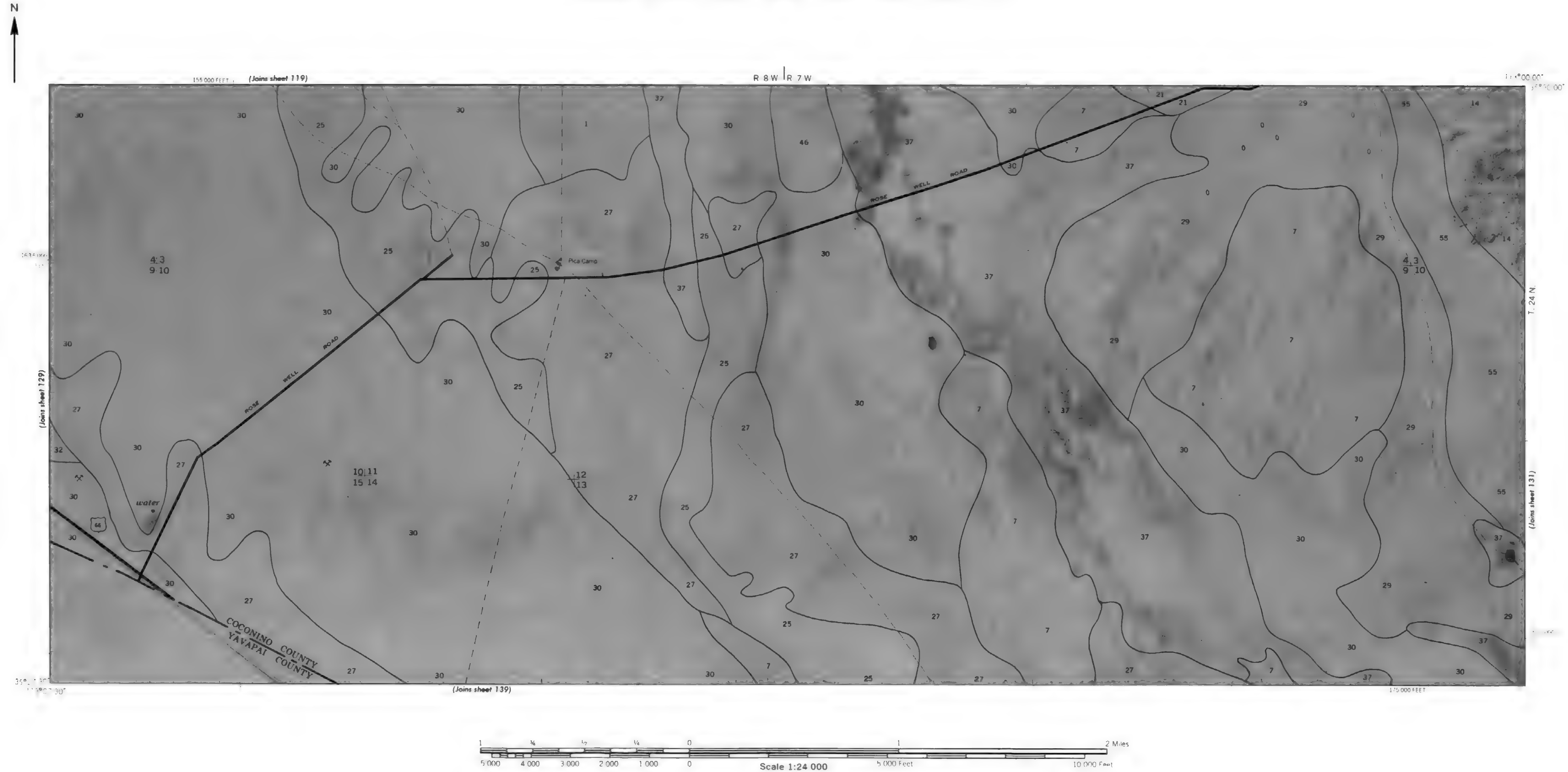
COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 128



COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 129

This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotography by the U.S. Department of Agriculture Soil Conservation Service and cooperating agencies. 5,000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

COCONINO COUNTY, ARIZONA, CENTRAL PART — SHEET NUMBER 130



Scale 1:24 000

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 130

This map was compiled on 1972 and 1973 U S Department of The Interior Geological Survey orthophotography by the U S Department of Agriculture Soil Conservation Service and cooperating agencies

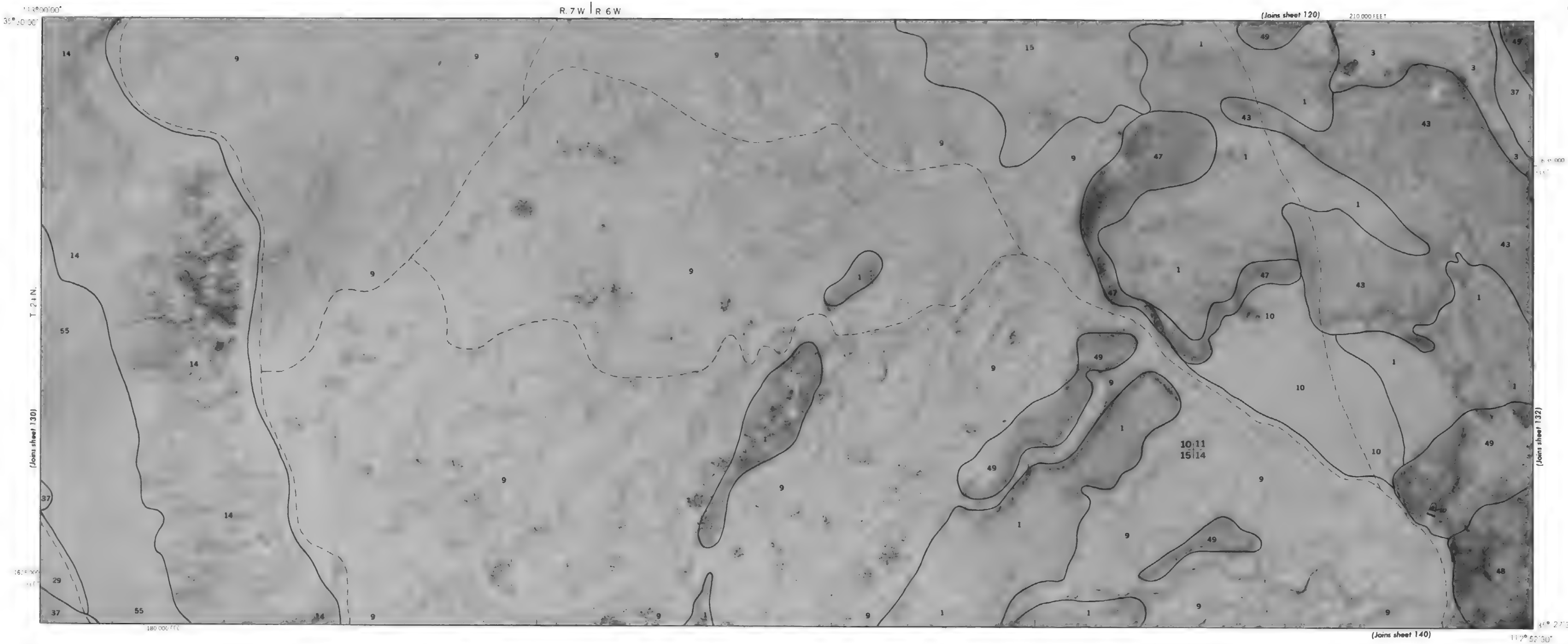
5,000 foot grid ticks based on state coordinate system ; land division corners , if shown, are approximately positioned

131

N

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 131

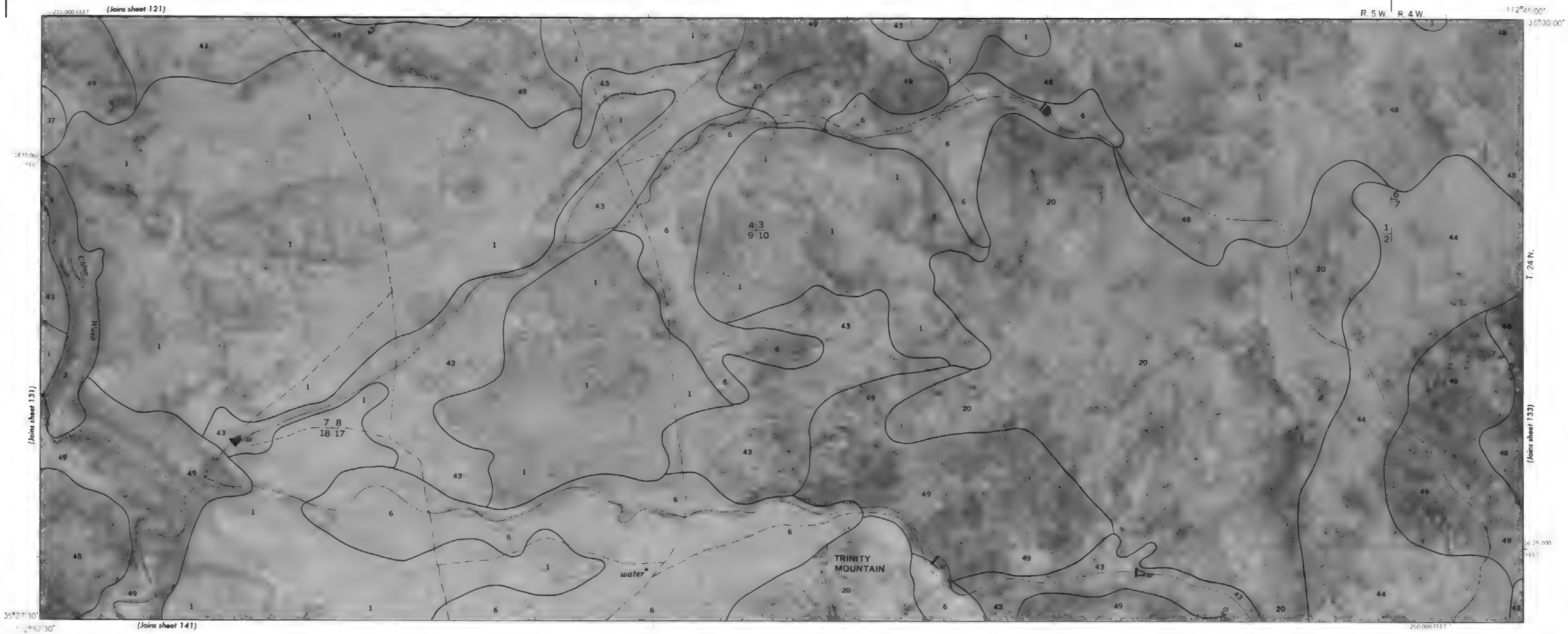
This map was compiled on 1972 and 1973 U.S. Department of the Interior, Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.



Scale 1:24 000

N

COCONINO COUNTY, ARIZONA, CENTRAL PART — SHEET NUMBER 132



1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

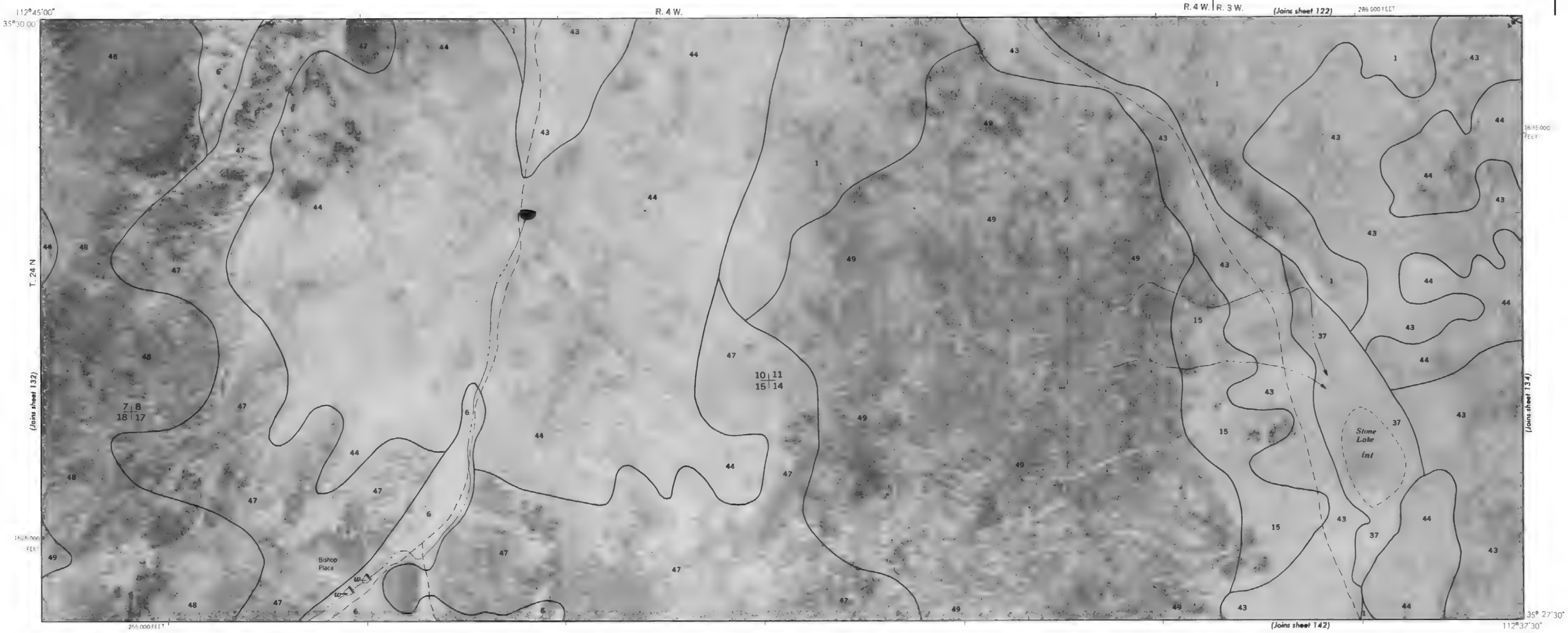
This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

133

N

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 133

This map was compiled on 1972 and 1973 U.S. Department of the Interior, Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000 foot grid ticks based on state coordinate system. Land division corners if shown are approximately positioned.

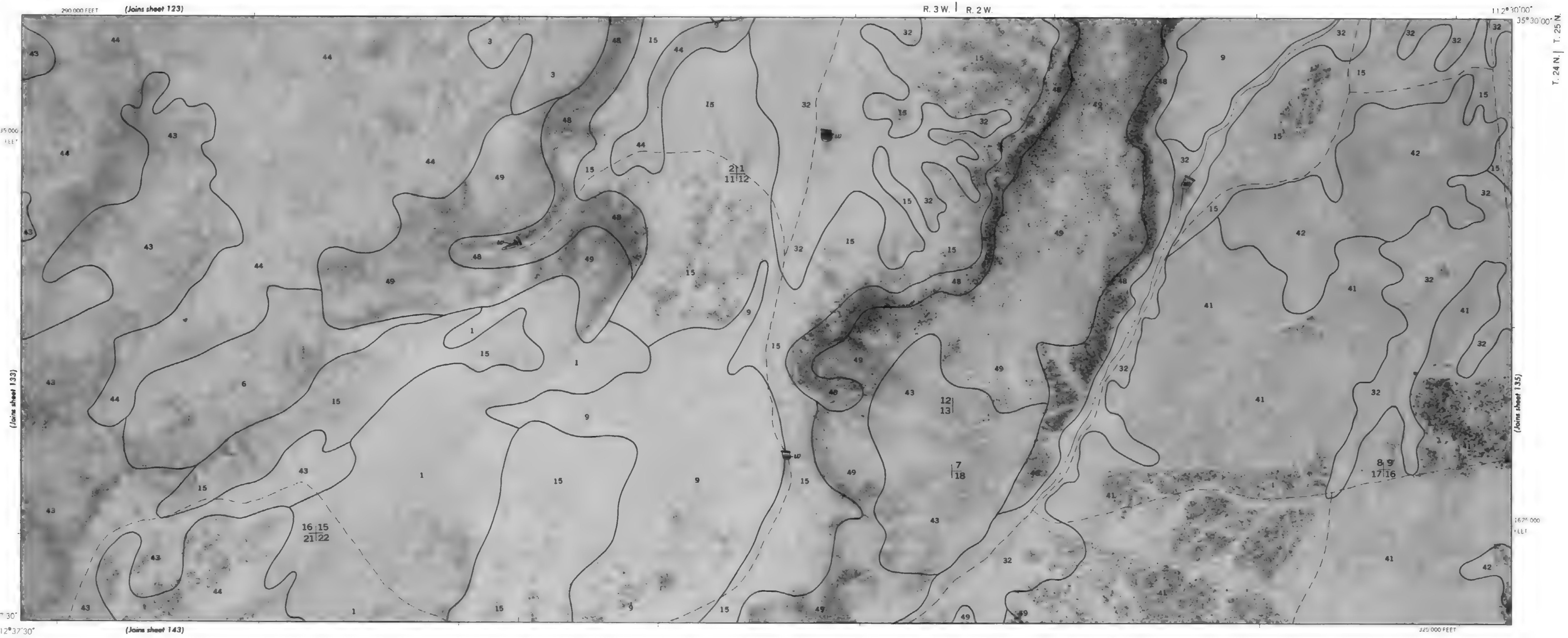


1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

N



1 ¾ ½ ¼ 0 1 2 Miles

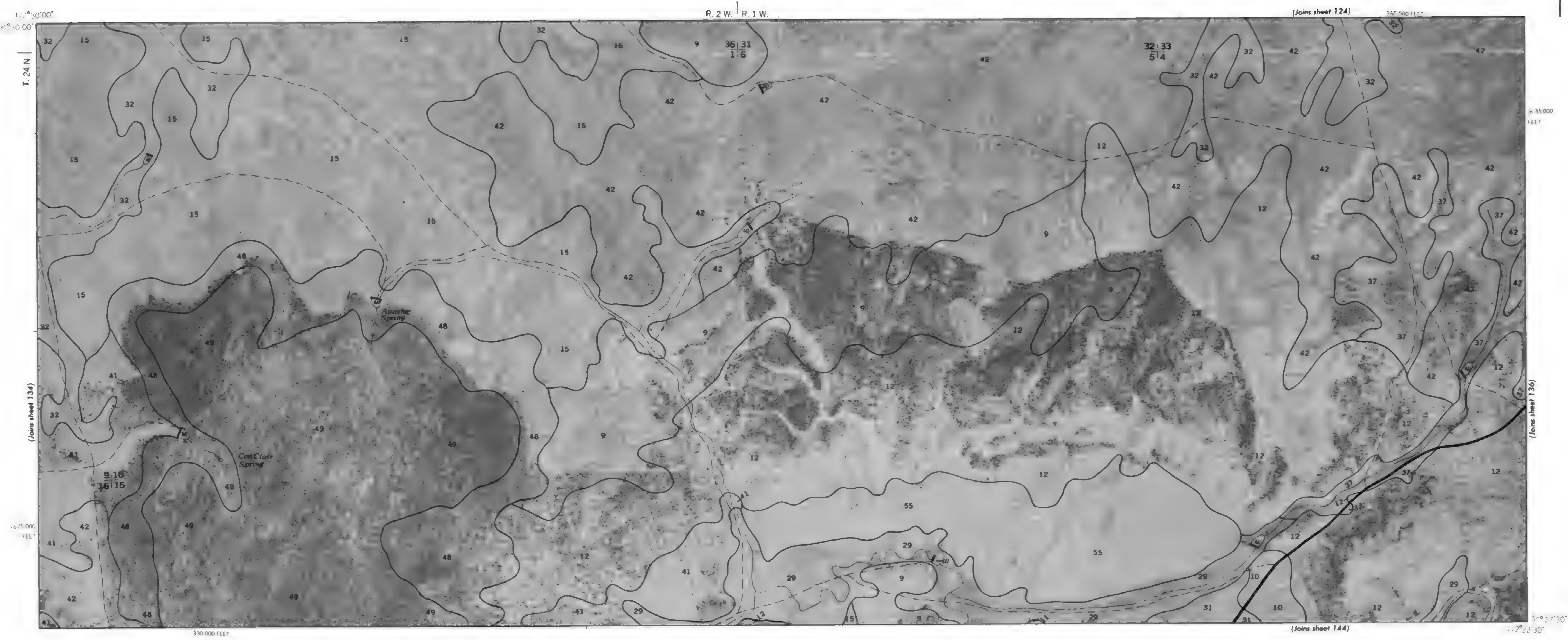
5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotography by the U.S. Department of Agriculture Soil Conservation Service and cooperating agencies.

This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.



1 ¾ ½ ¼ 0 1 2 Miles
5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet
Scale 1:24 000

5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

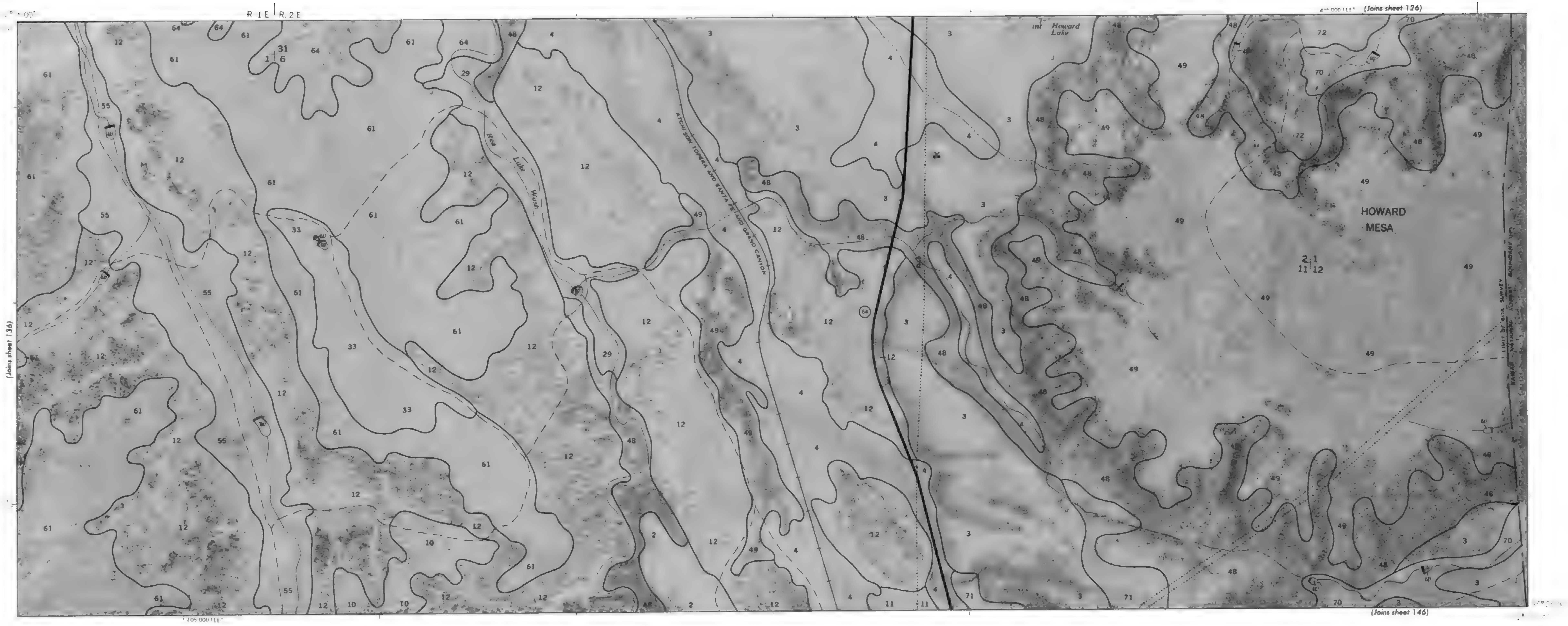
This map was compiled on 1972 and 1973 U.S. Department of The Interior Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 136

N

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 137

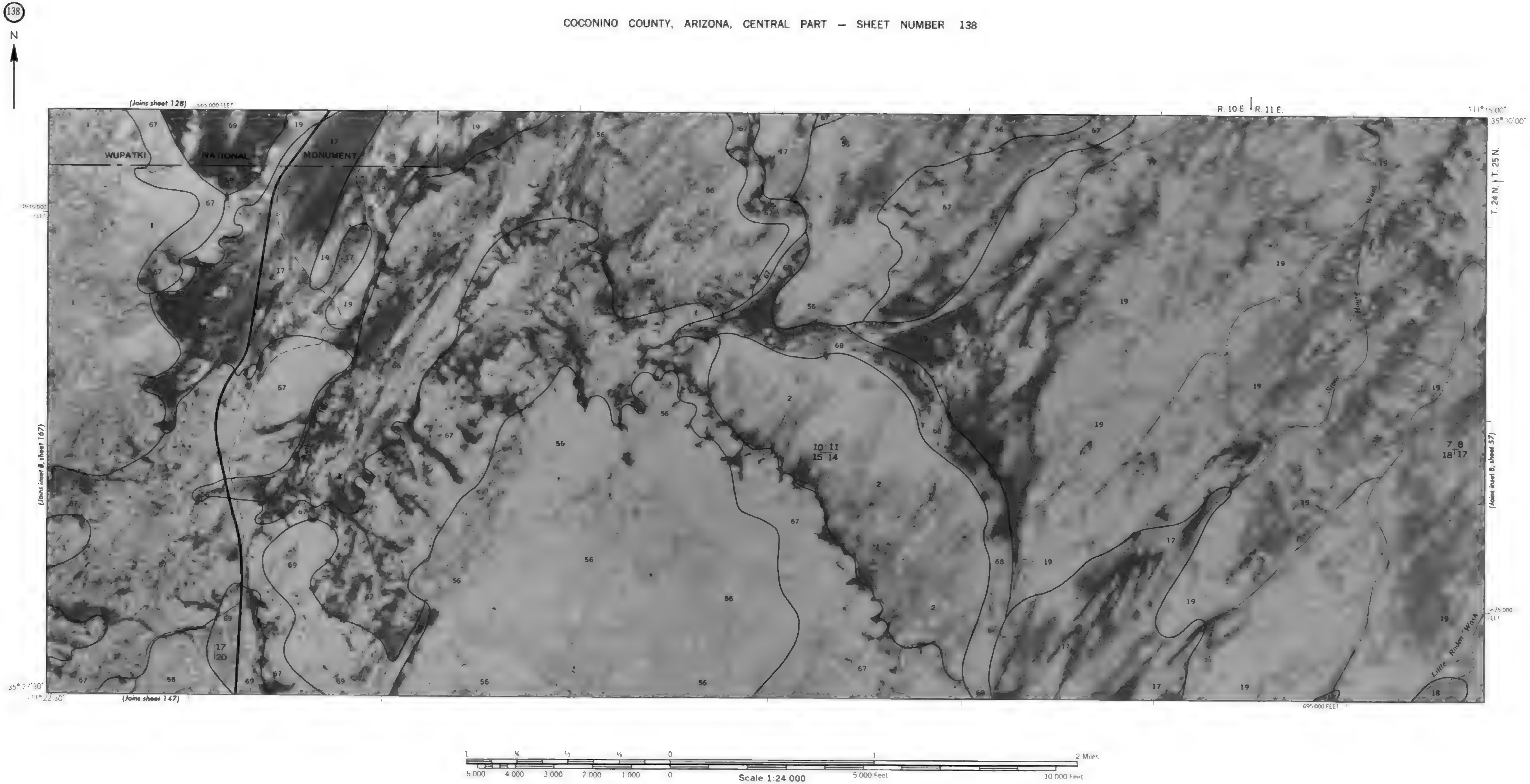
This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotographs by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. 5,000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.



Scale 1:24 000

1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet



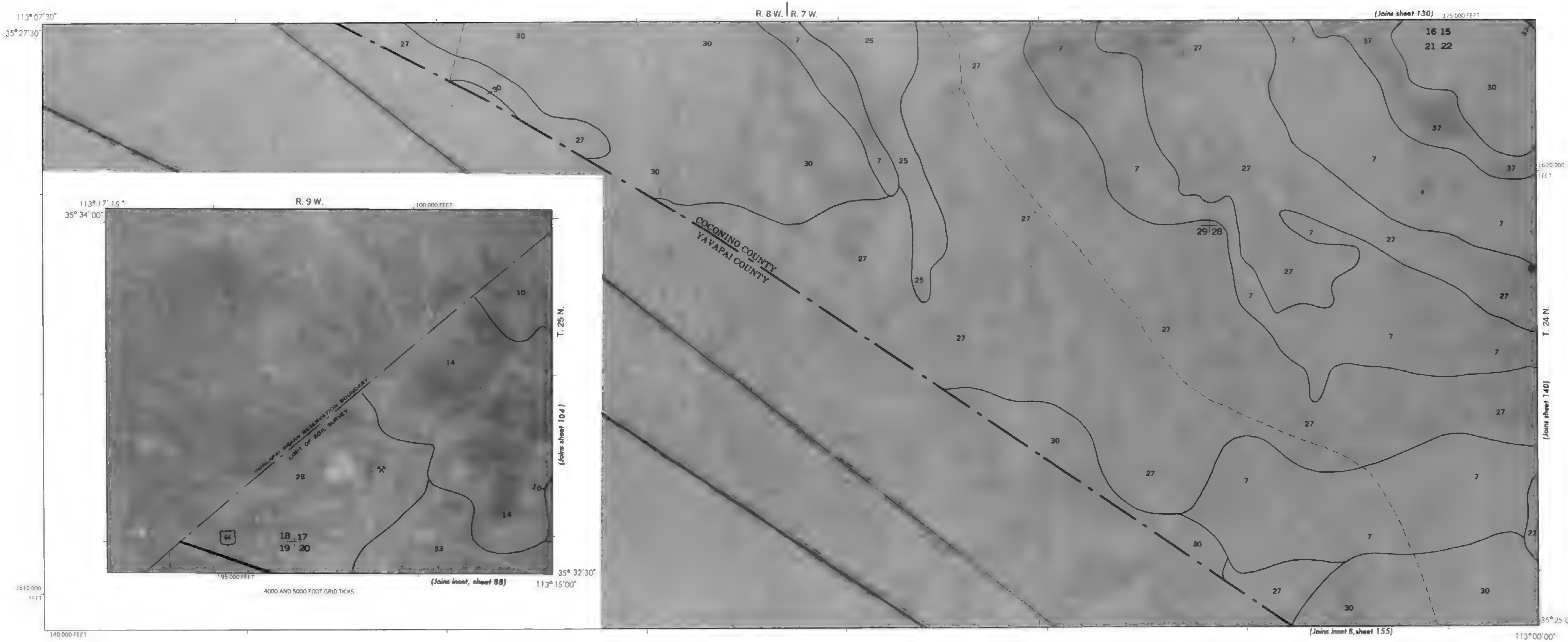
5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 138

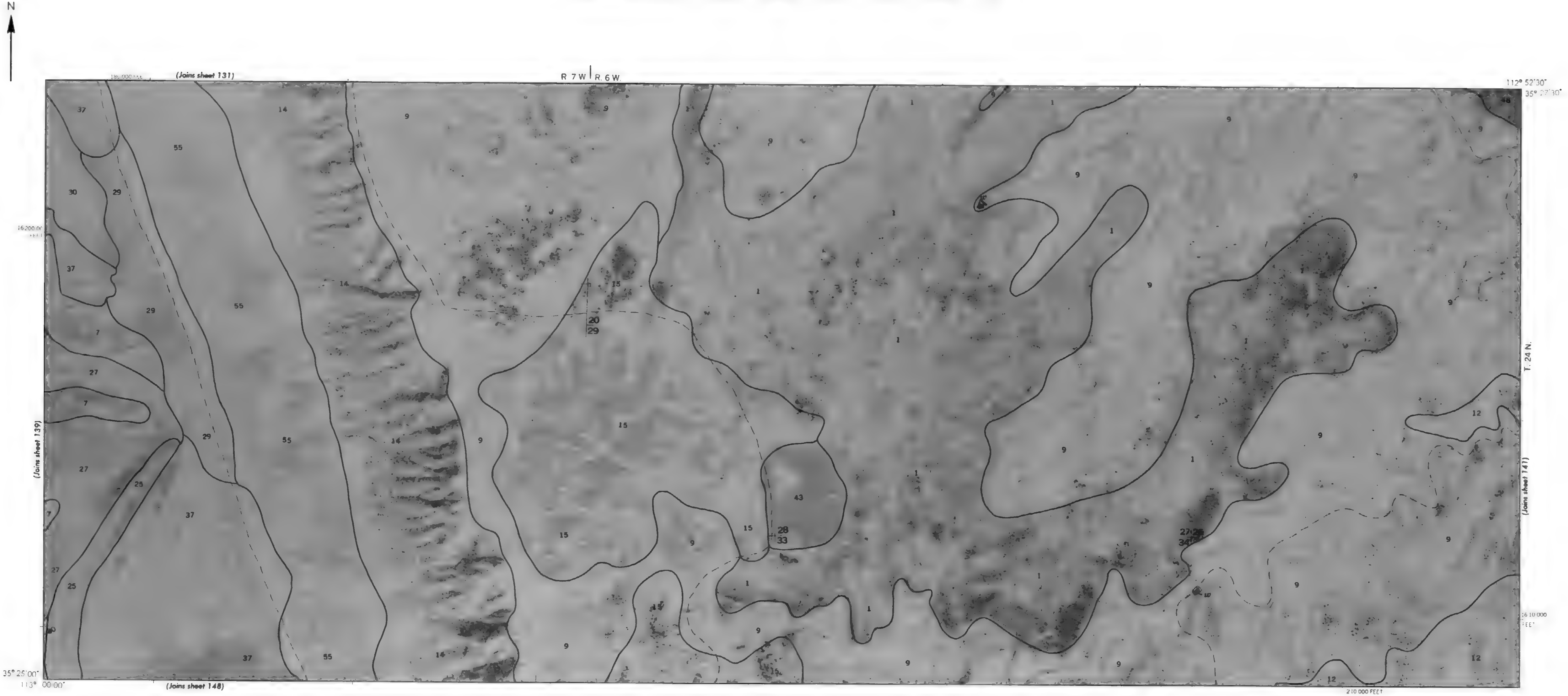
COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 139

This map was compiled on 1972 and 1973 U.S. Department of the Interior, Geological Survey orthophotographs by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.



1 ¾ ½ ¼ 0 1 2 Miles
5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet
Scale 1:24 000

COCONINO COUNTY, ARIZONA, CENTRAL PART — SHEET NUMBER 140



1 ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

This map was compiled on 1972 and 1973 U.S. Department of the Interior, Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 140

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 141

5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1972 and 1973 U.S. Department of The Interior Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 142

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 143

This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. 5,000 foot grid ticks based on state coordinate system. Land division corners if shown are approximately positioned.

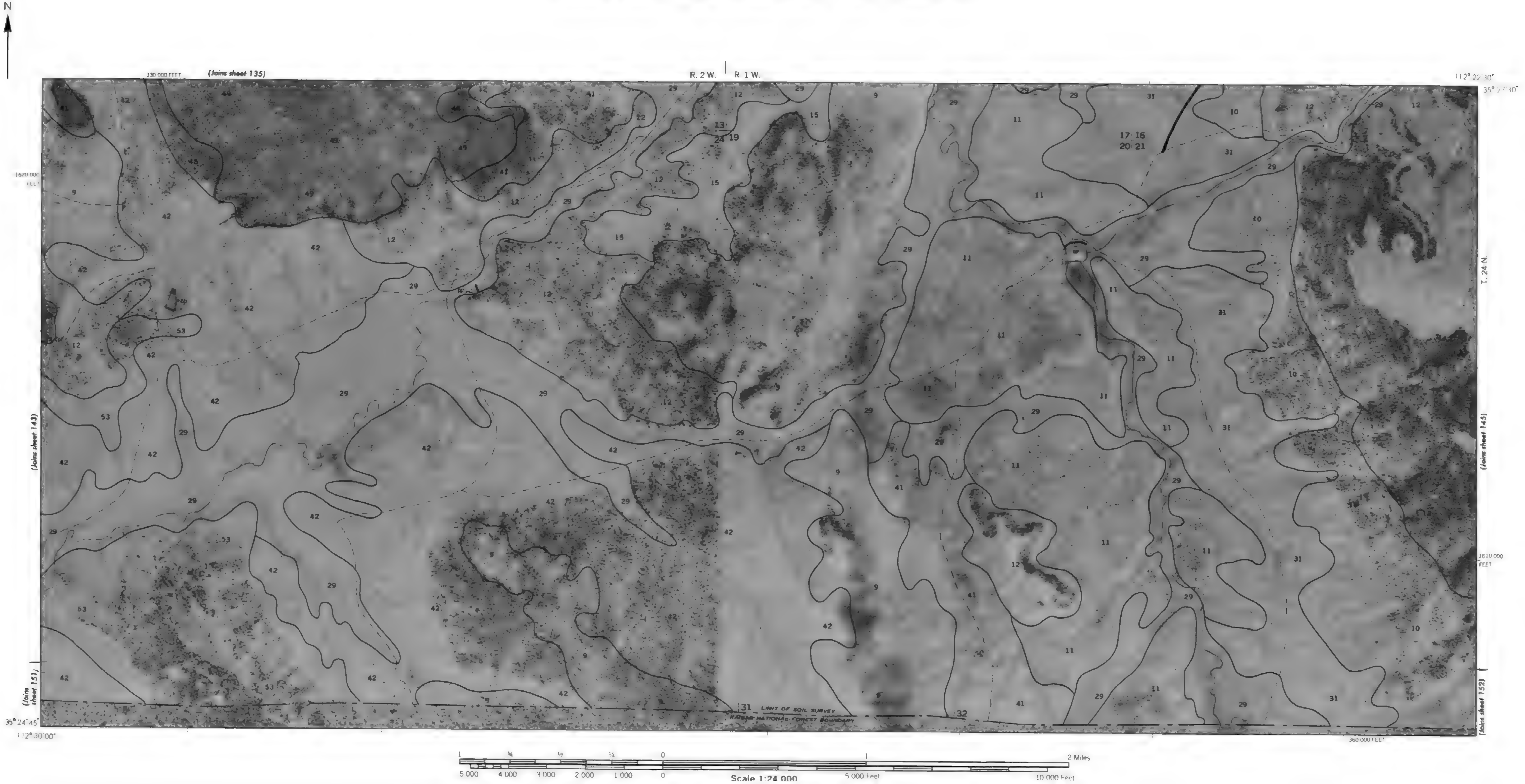
Scale 1:24 000

1 ½ 0 1 2 Miles

5,000 4,000 3,000 2,000 1,000 0 5,000 Feet 10,000 Feet

144

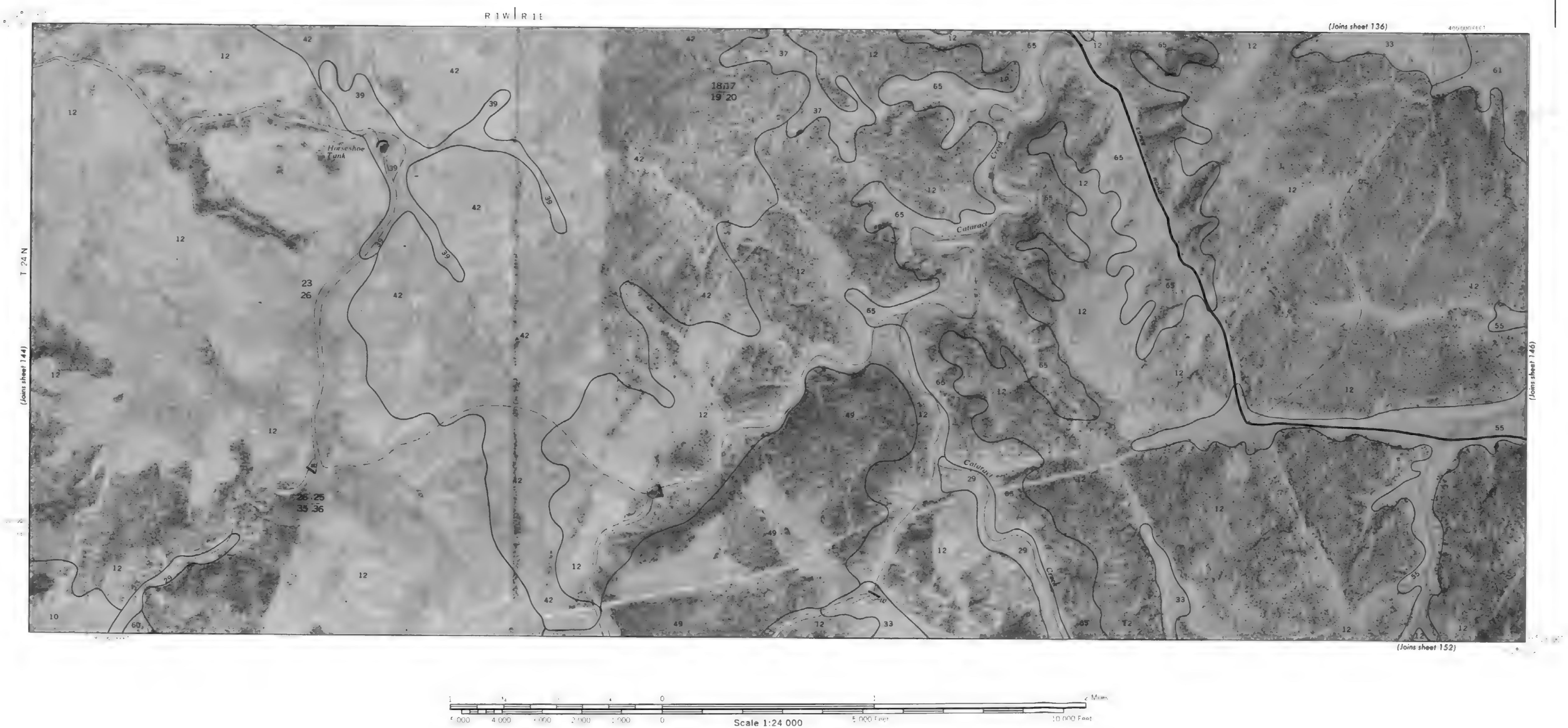
COCONINO COUNTY, ARIZONA, CENTRAL PART — SHEET NUMBER 144



5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1972 and 1973 U.S. Department of The Interior Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 144

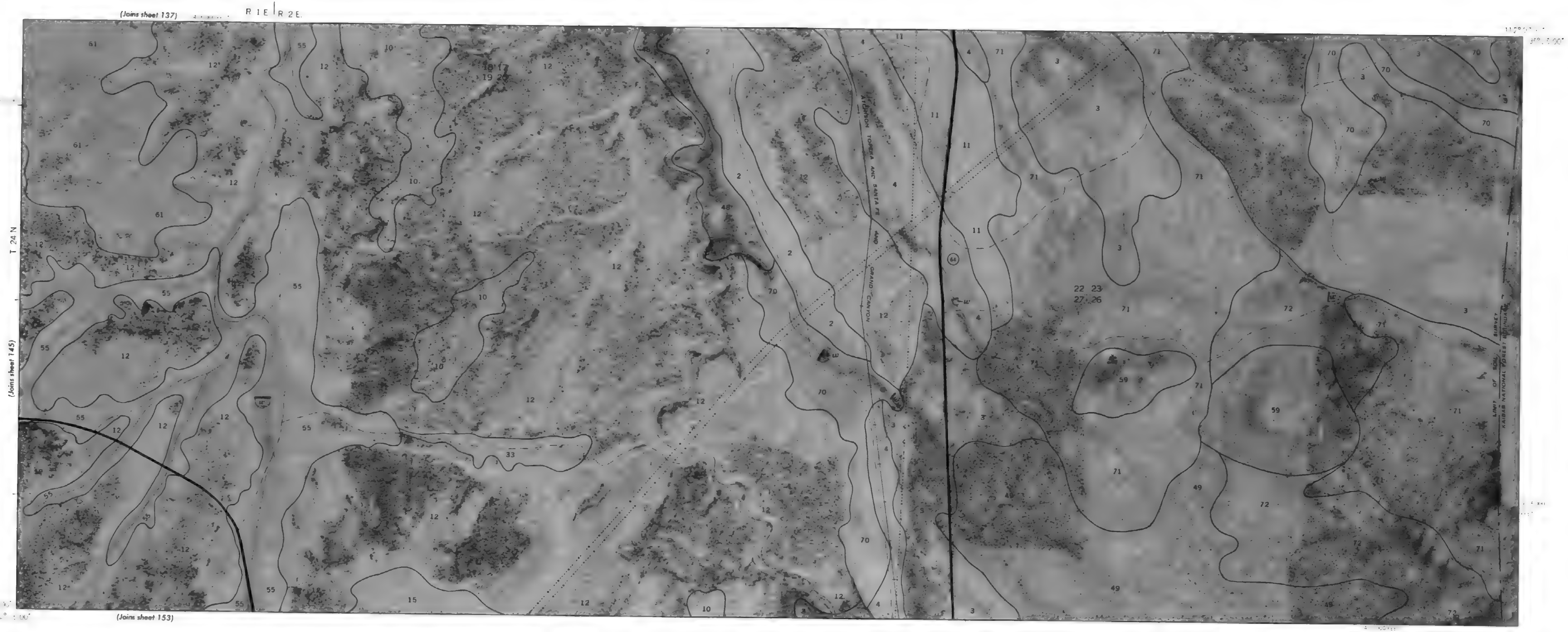


COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 145

This map was compiled on 1972 and 1973 U.S. Department of The Interior, Geological Survey orthophotographs by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

N

COCONINO COUNTY, ARIZONA, CENTRAL PART — SHEET NUMBER 146



1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

5 000-foot grid ticks based on state coordinate system 3 and division corners, if shown, are approximately positioned.

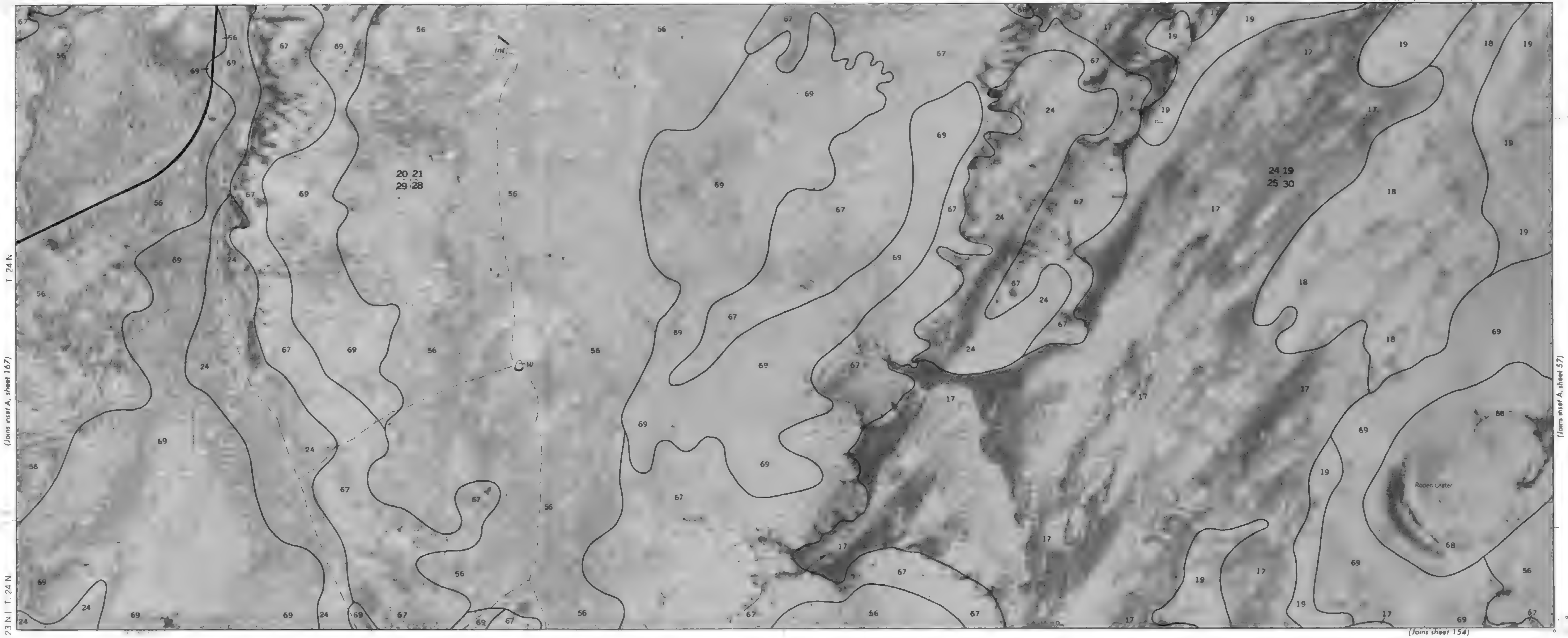
This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 146

(147)

N

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 147



Scale 1:24 000

1 ½ 0 1 2 Miles

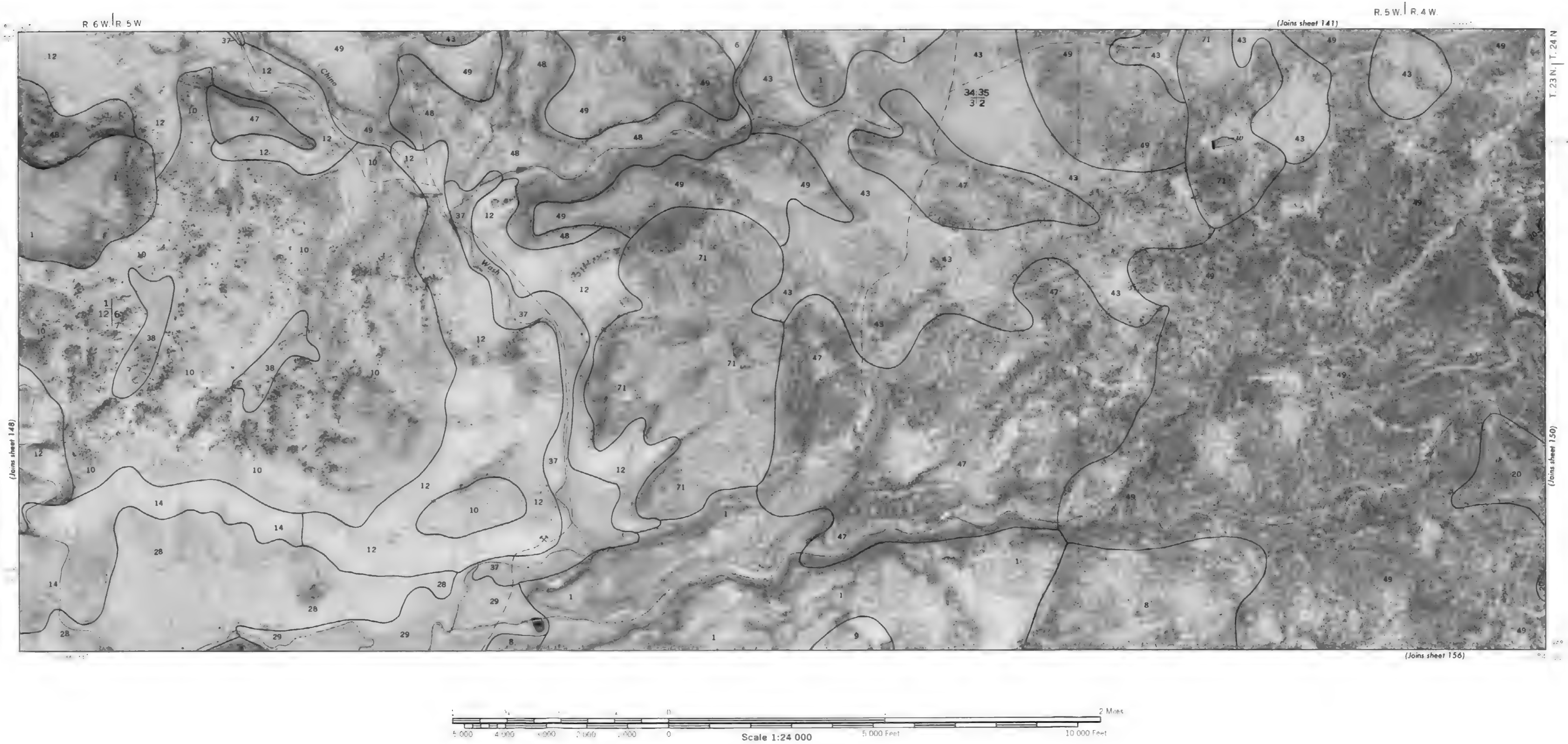
5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 148

149

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 149

This map was compiled on 1972 and 1973 U.S. Department of the Interior, Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.



N

COCONINO COUNTY, ARIZONA, CENTRAL PART — SHEET NUMBER 150

1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

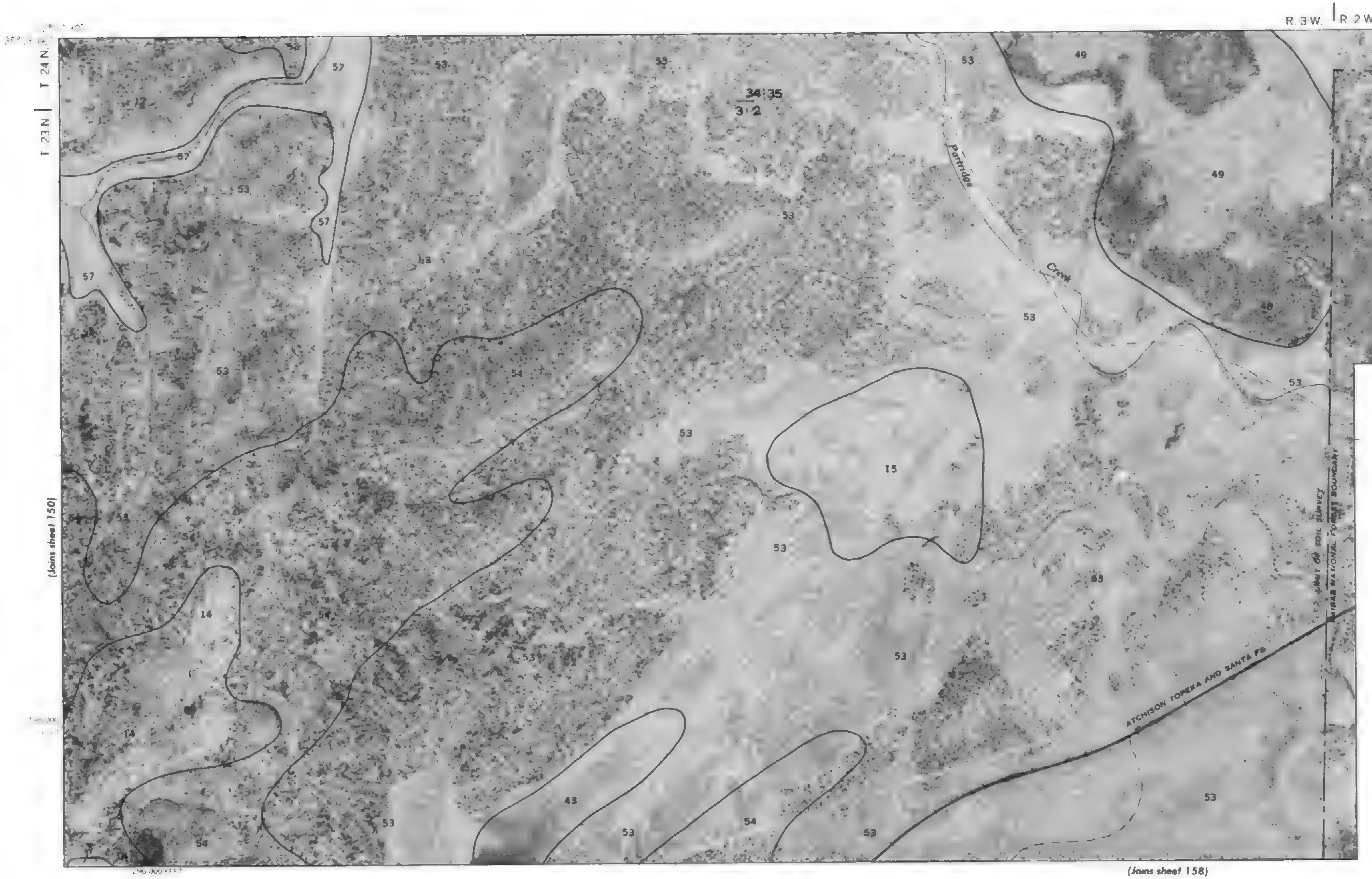
Scale 1:24 000

5 000 foot grid ticks based on state coordinate system ... Land division corners, if shown, are approximately positioned

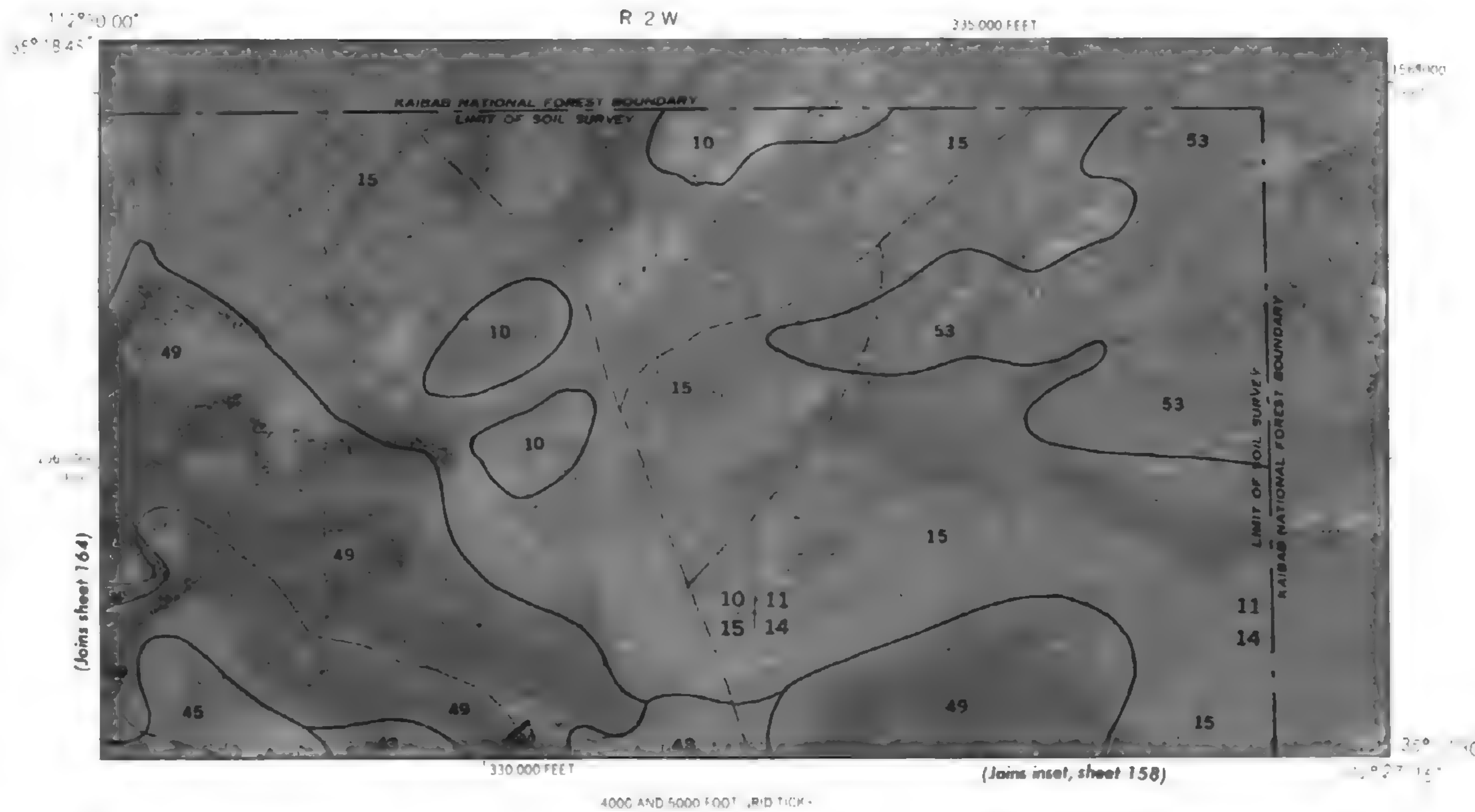
This map was compiled on 1972 and 1973 U.S. Department of the Interior, Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies

N

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 151



INSET



Scale 1:24 000

2 Miles

5 000 Feet

10 000 Feet

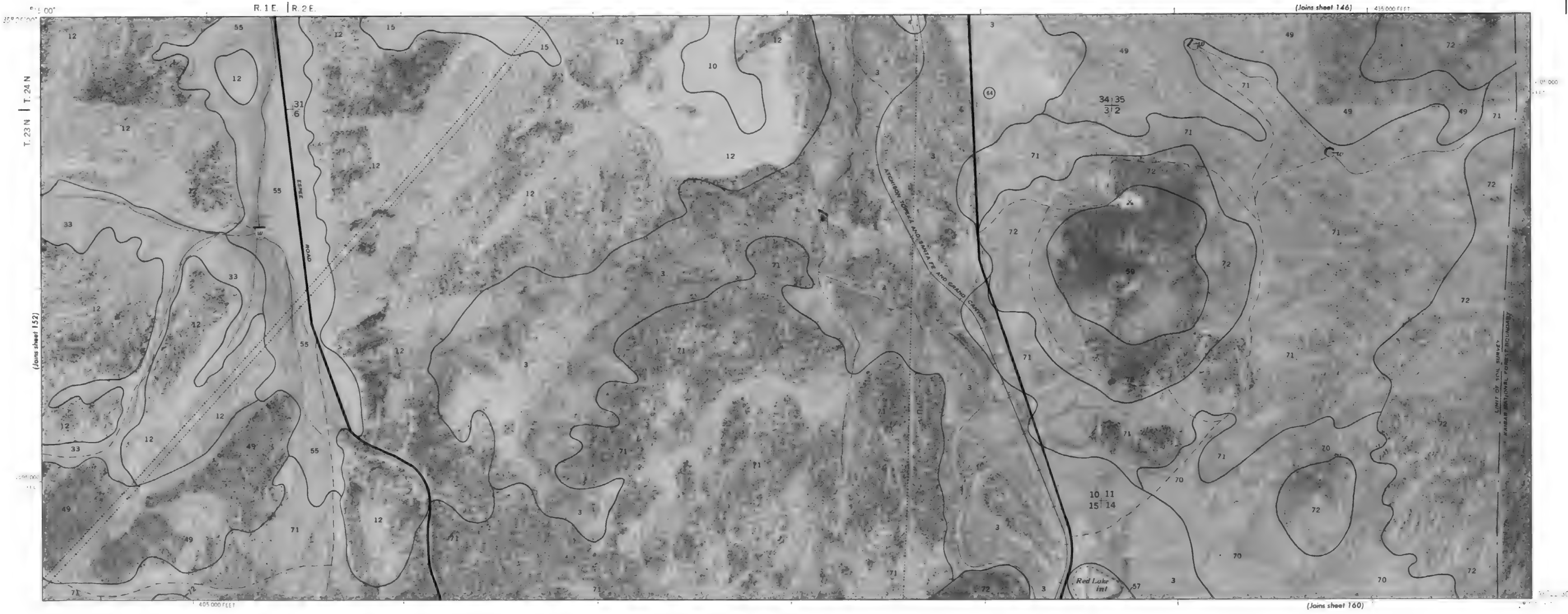
1 ¾ ½ ¼ 0 1 2 Miles
5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet
Scale 1:24 000

5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotographs by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

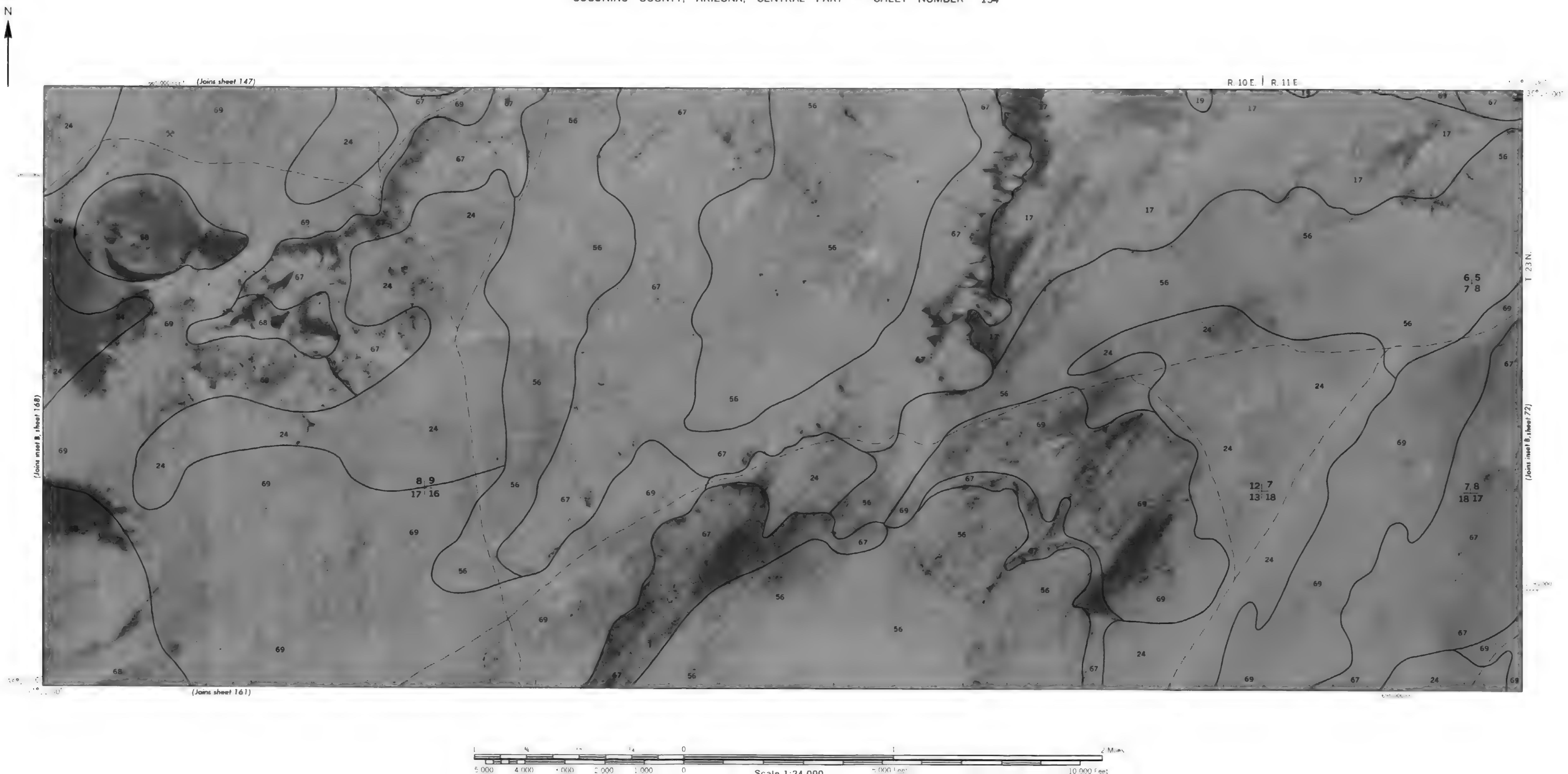
COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 153

This map was compiled on 1972 and 1973 U.S. Department of the Interior, Geological Survey, orthophotographs by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

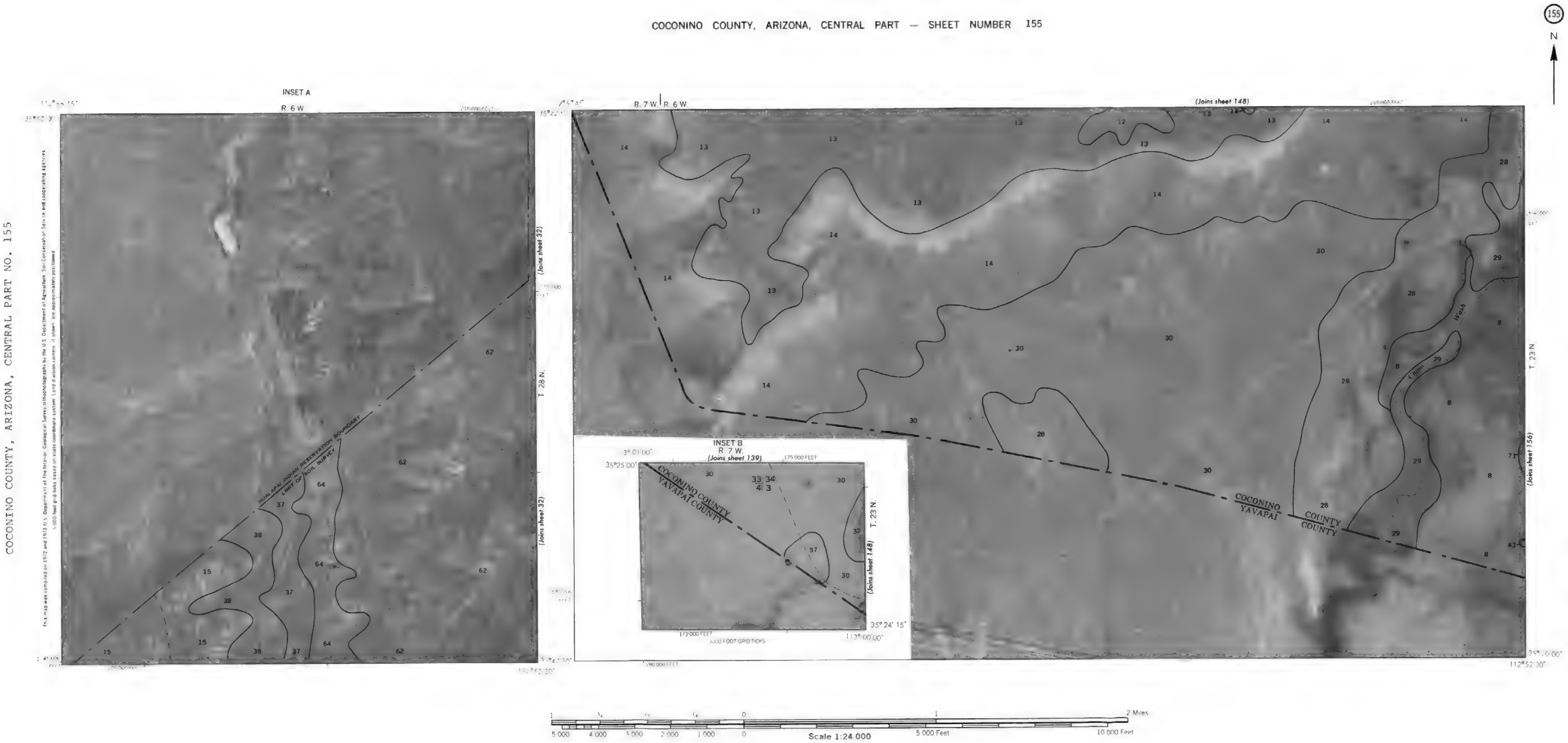


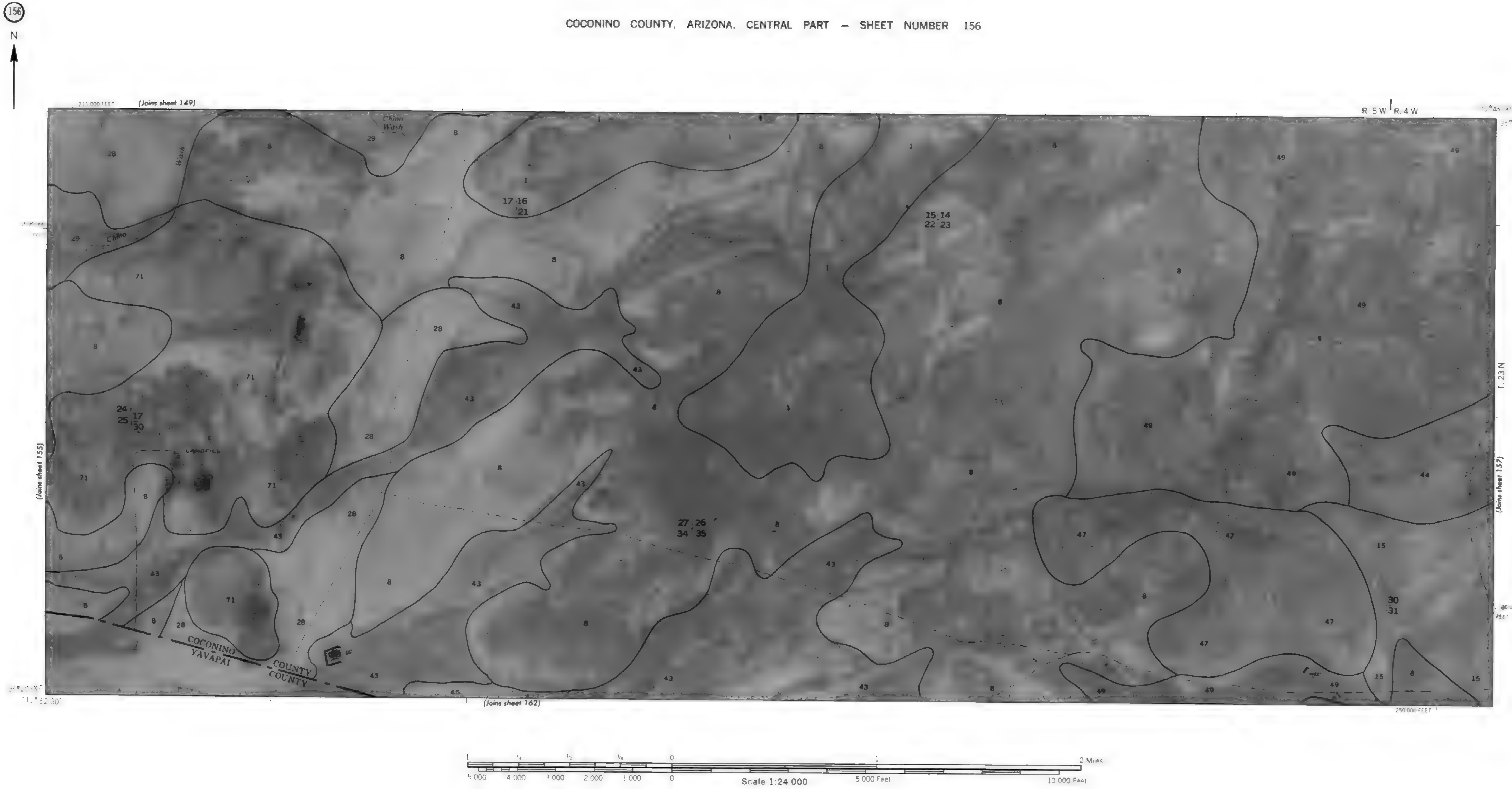
1 ¾ ½ ¼ 0 1 2 Miles
5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet
Scale 1:24 000

COCONINO COUNTY, ARIZONA, CENTRAL PART — SHEET NUMBER 154



COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 154


155
N
COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 155
INSET A
R. 6 W.
T. 28 N.
(Joins sheet 32)
HUALAPAI INDIAN RESERVATION BOUNDARY
LIMIT OF SOIL SURVEY
15
38
37
64
62
R. 7 W. | R. 6 W.
(Joins sheet 148)
(Joins sheet 156)
T. 23 N.
12
13
14
28
29
30
8
71
43
Chino Wash
COCONINO COUNTY
YAVAPAI COUNTY
INSET B
R. 7 W.
(Joins sheet 139)
175 000 FEET
35°25'00"
33 | 34
4 | 3
35°24' 15"
113°00'00"
172 000 FEET
5000 FOOT GRID TICKS
190 000 FEET
35°20'00"
112°52'30"
2 Miles
Scale 1:24 000
5 000 Feet
10 000 Feet



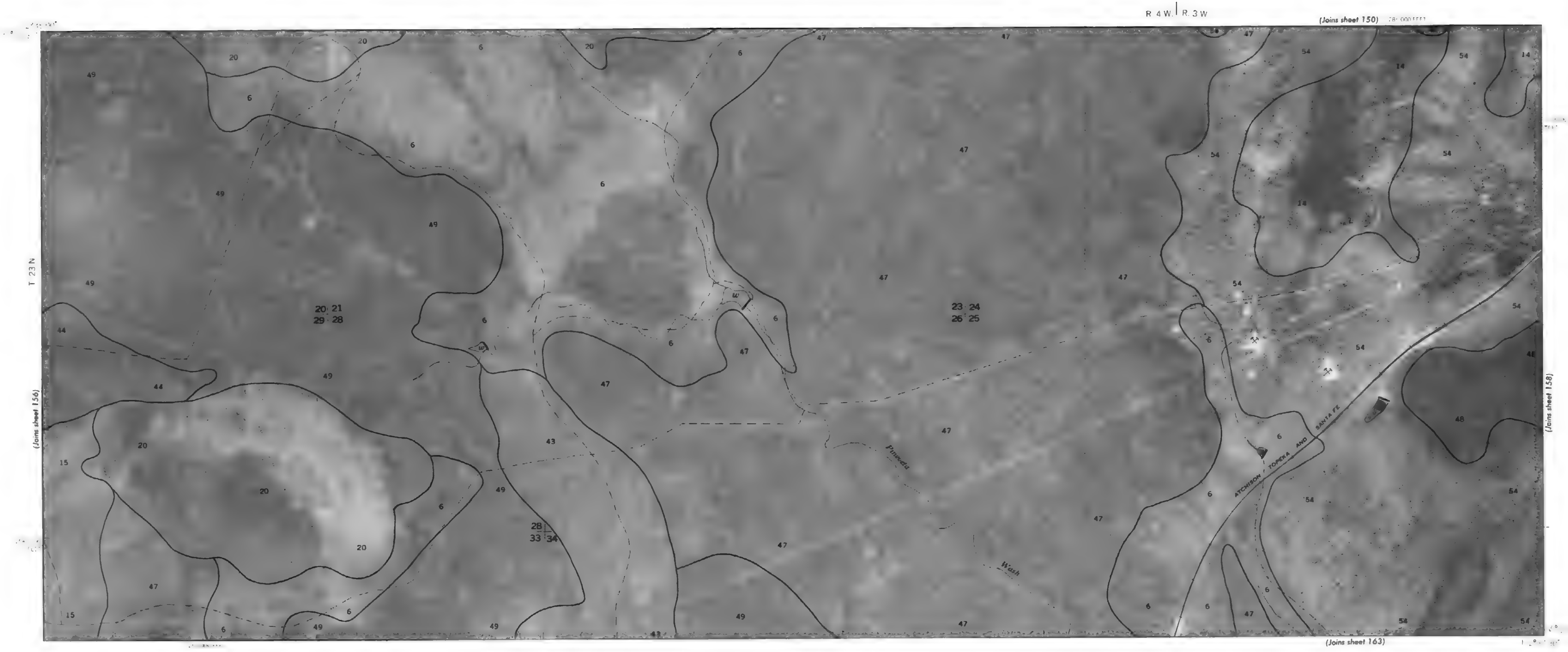
5,000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotographs by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 156

157

N



2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

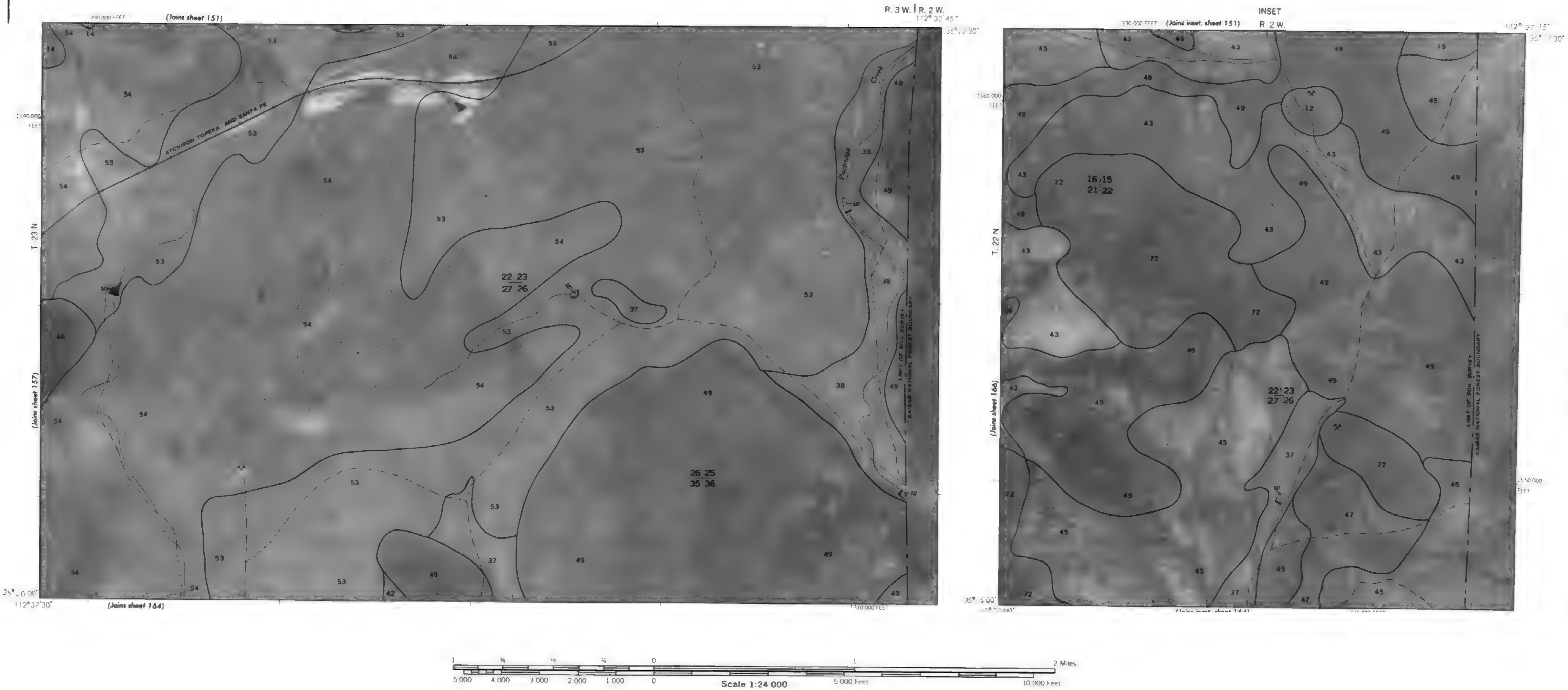
Scale 1:24 000

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 157

This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotographs by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

158

N

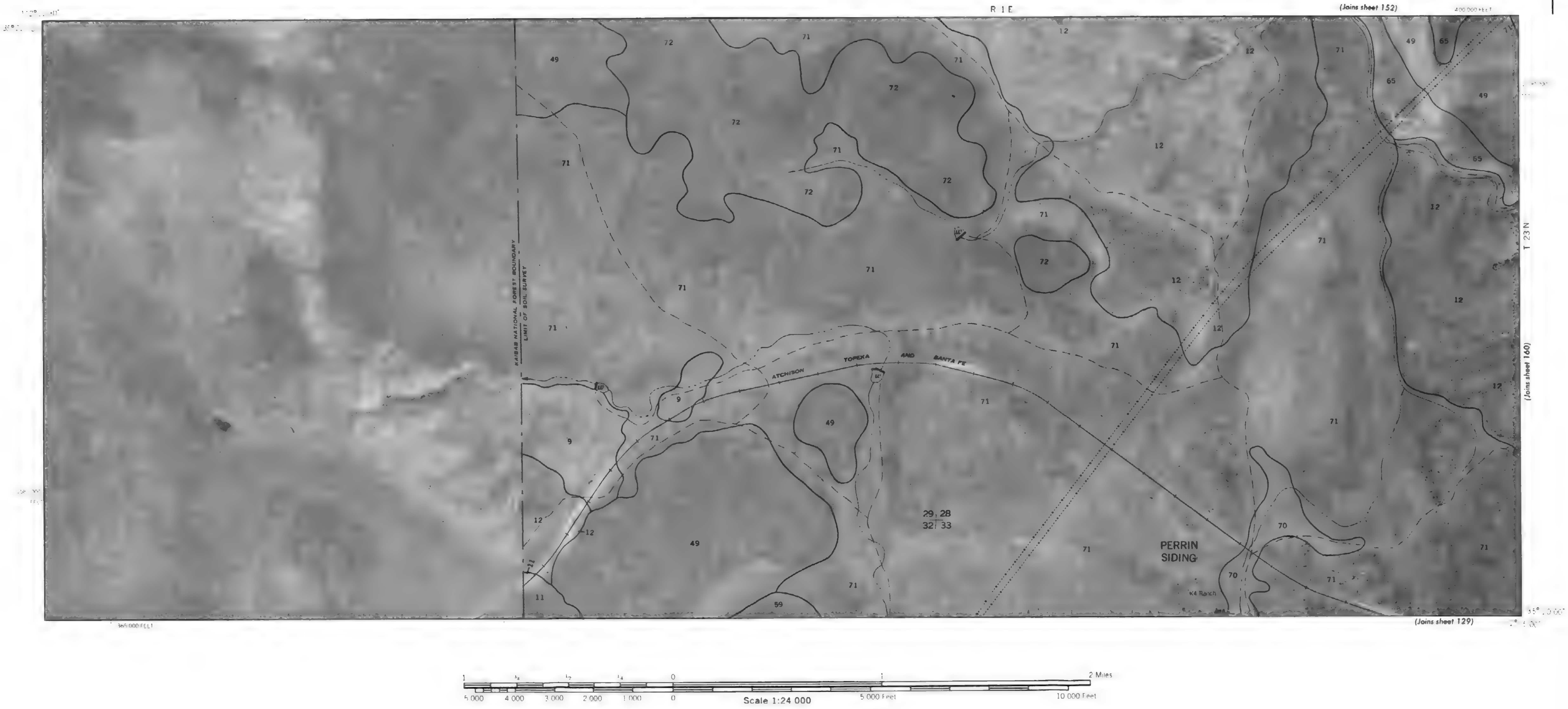


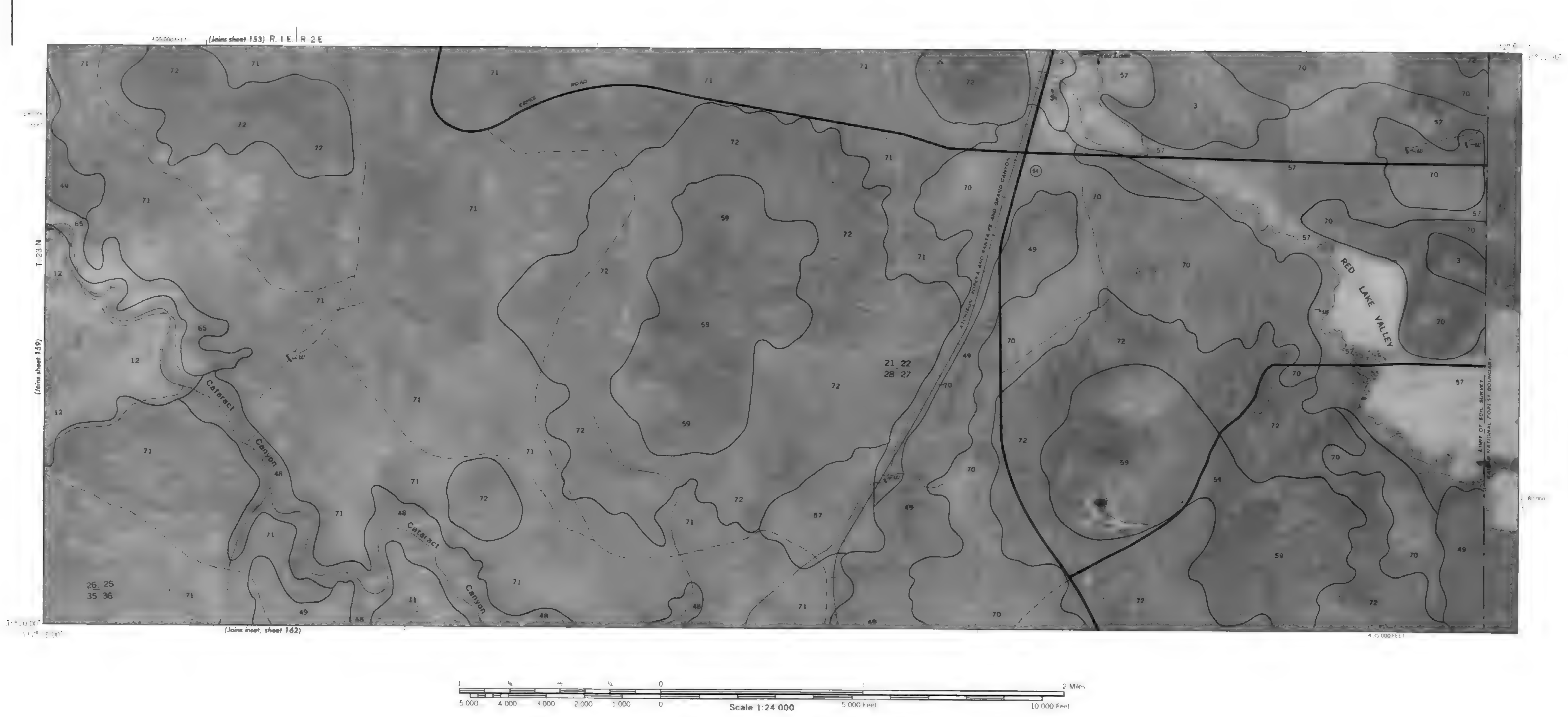
COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 158

N

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 159

This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotography by the U.S. Department of Agriculture Soil Conservation Service and cooperating agencies. 5,000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

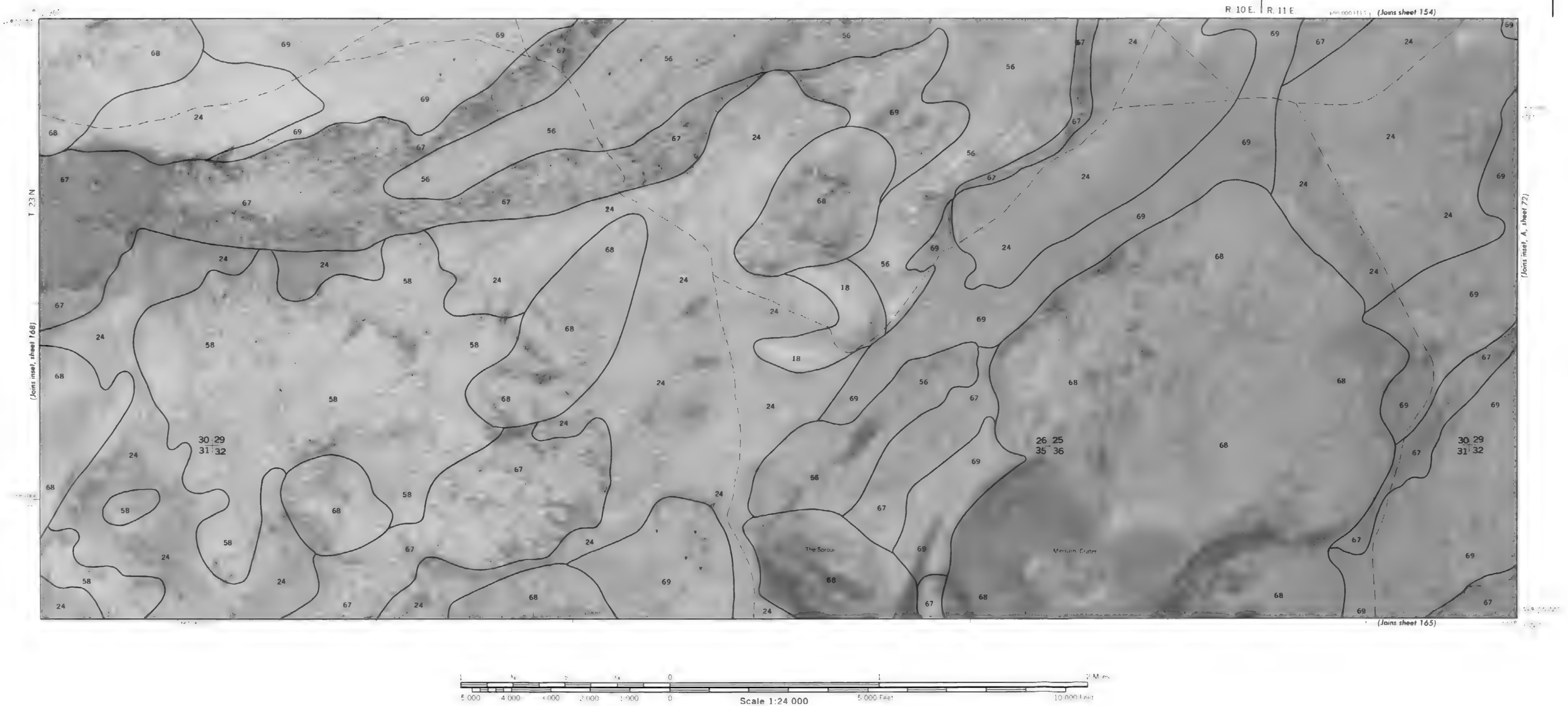




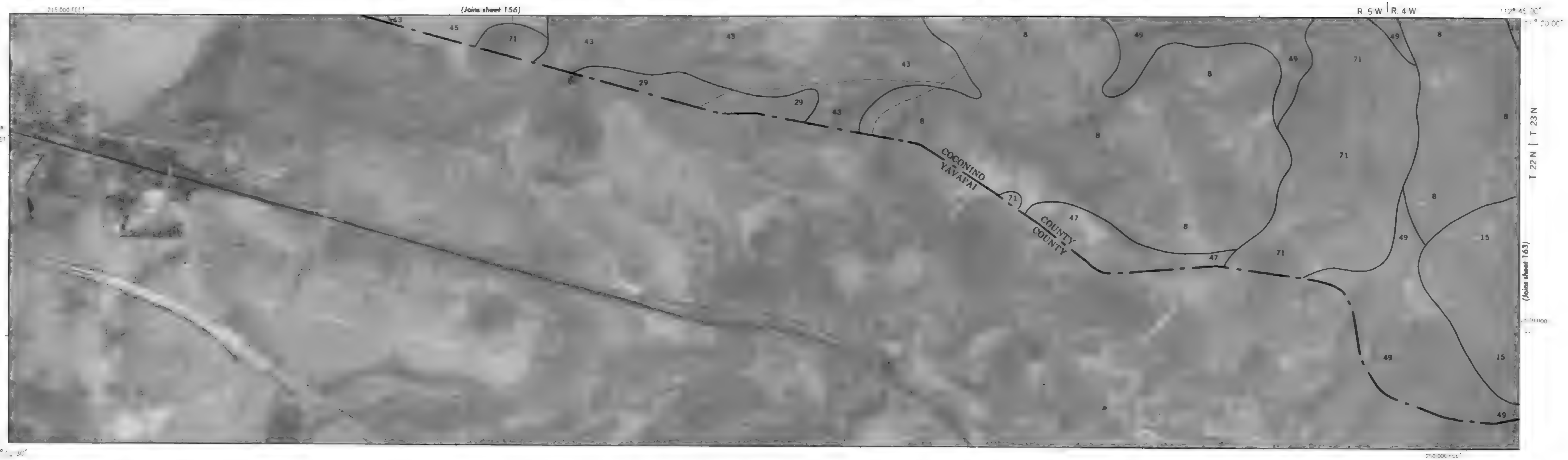
This map was compiled on 1972 and 1973 U.S. Department of the Interior, Geological Survey orthophotographs by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5 000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 161

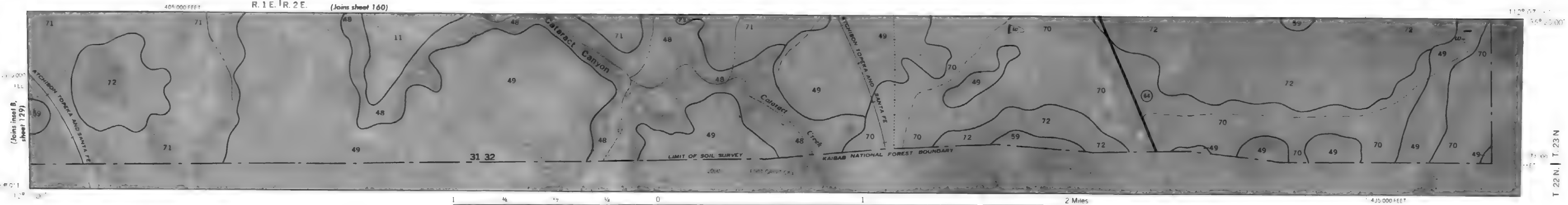
This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. 5,000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.



COCONINO COUNTY, ARIZONA, CENTRAL PART — SHEET NUMBER 162



INSET



Scale 1:24 000

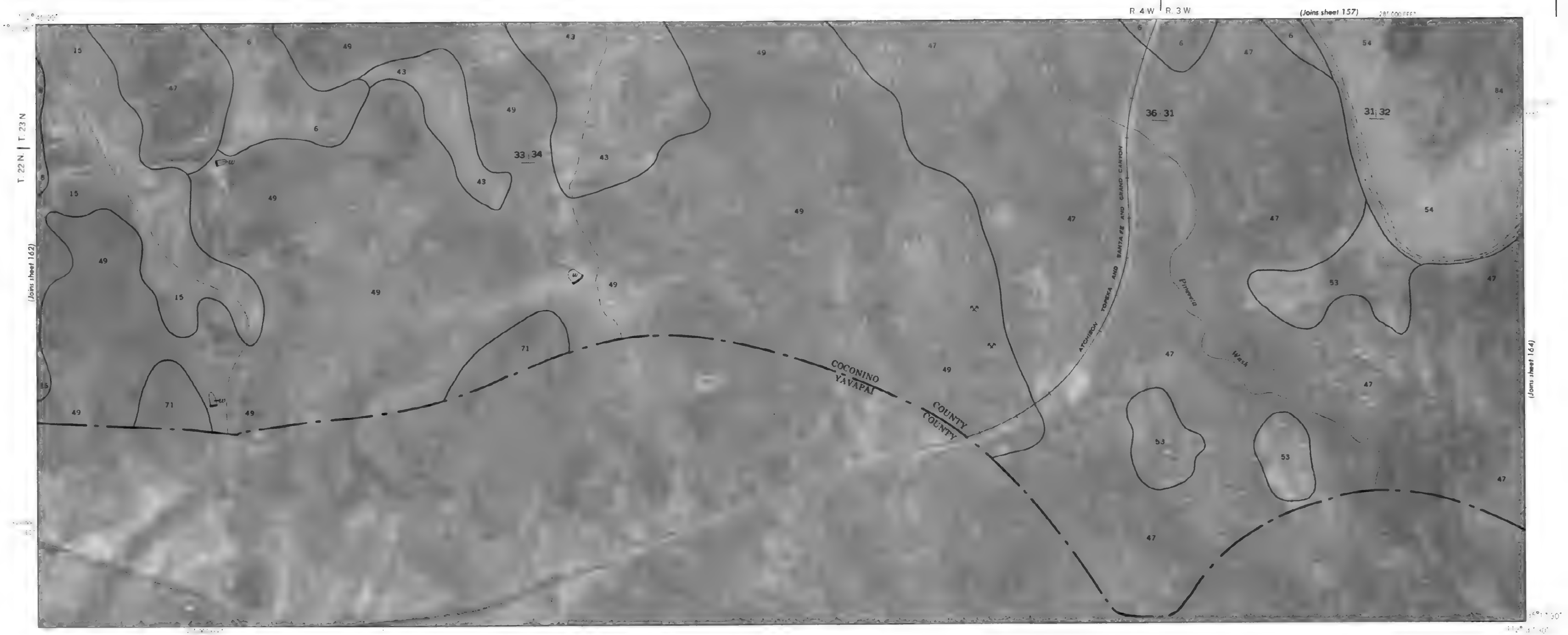
5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1972 and 1973 U.S. Department of the Interior, Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 162

N

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 163



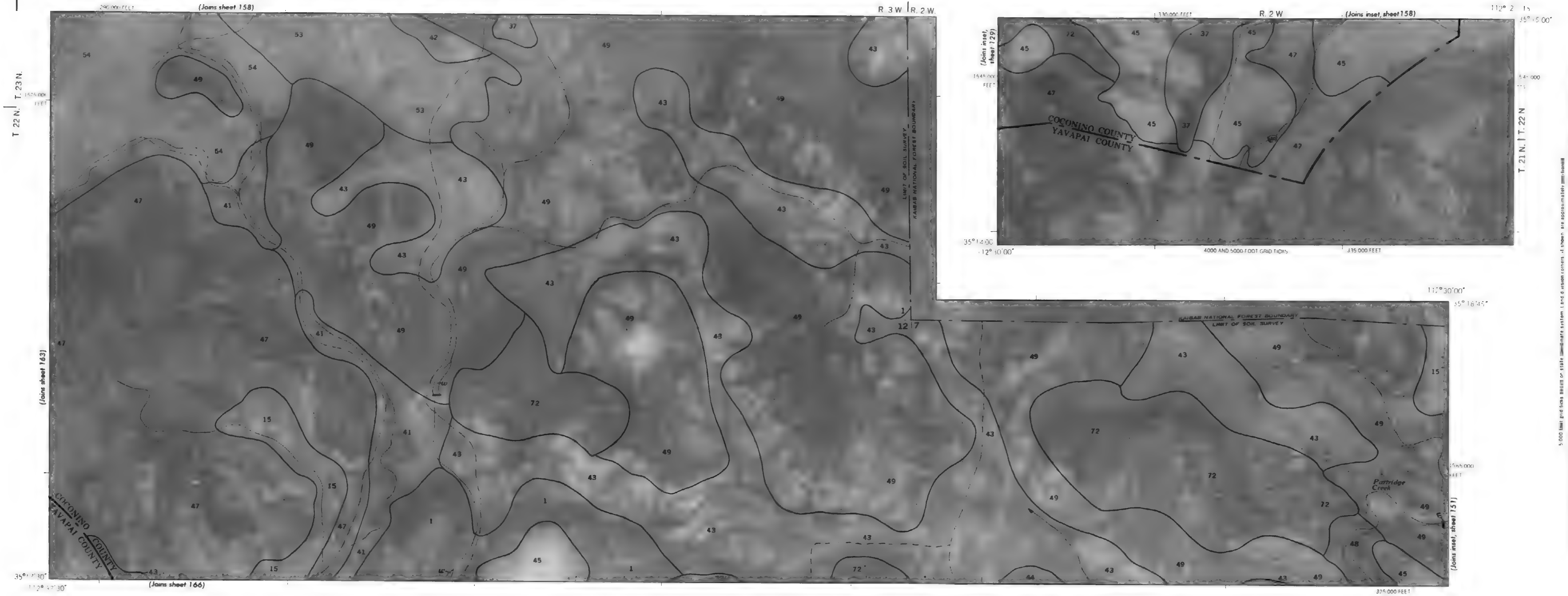
1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

164

N

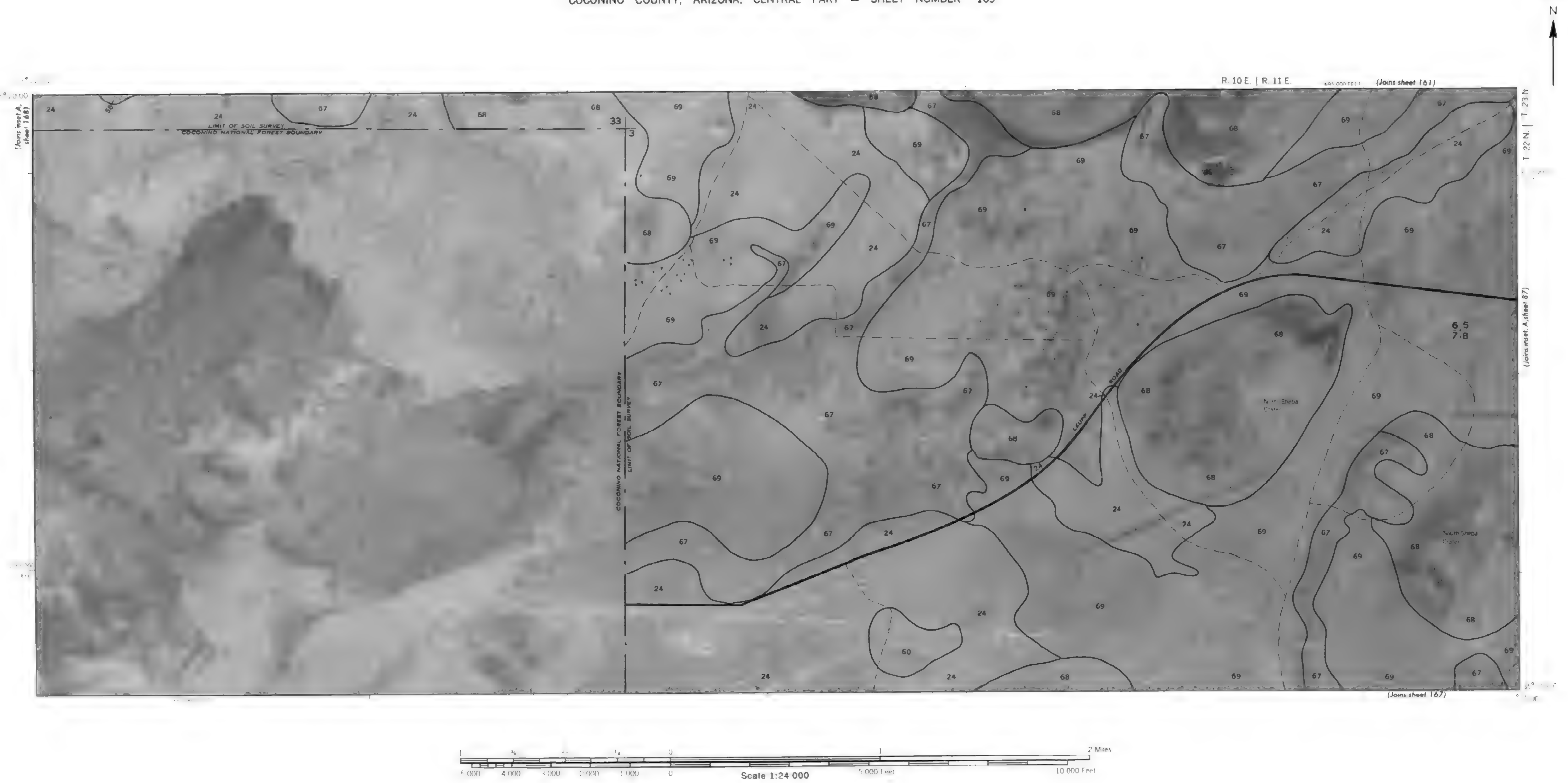


Scale 1:24 000

1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

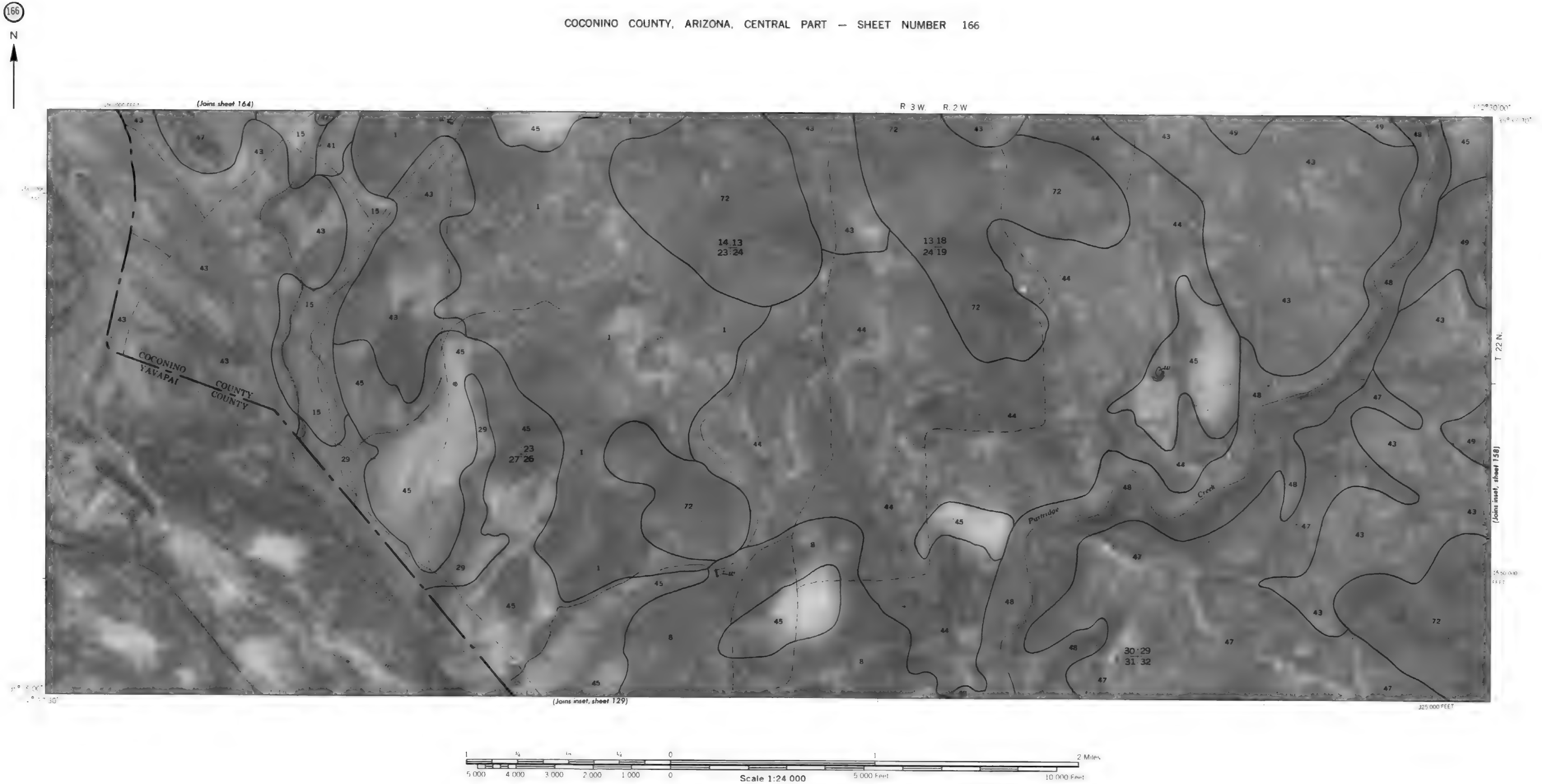
COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 164



Scale 1:24 000

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 165

This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.



5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 166

167

N

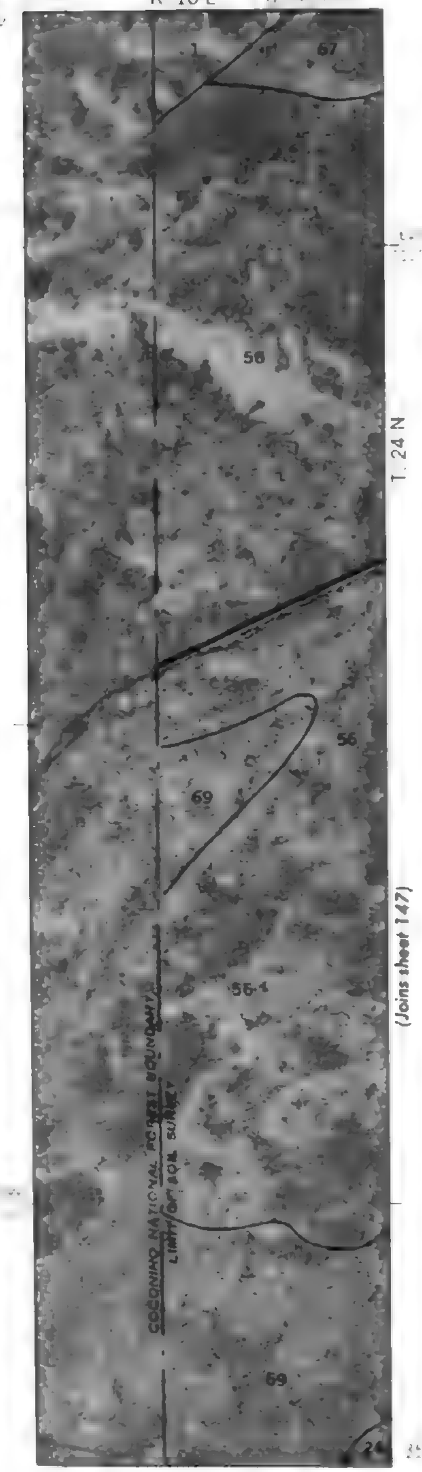
COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 167

This map was compiled on 1972 and 1973 U.S. Department of the Interior, Geological Survey orthophotographs by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

INSET A

(Joins inset B, lower right)

R. 10 E.



(Joins sheet 147)

(Joins inset B, sheet 168)

INSET B

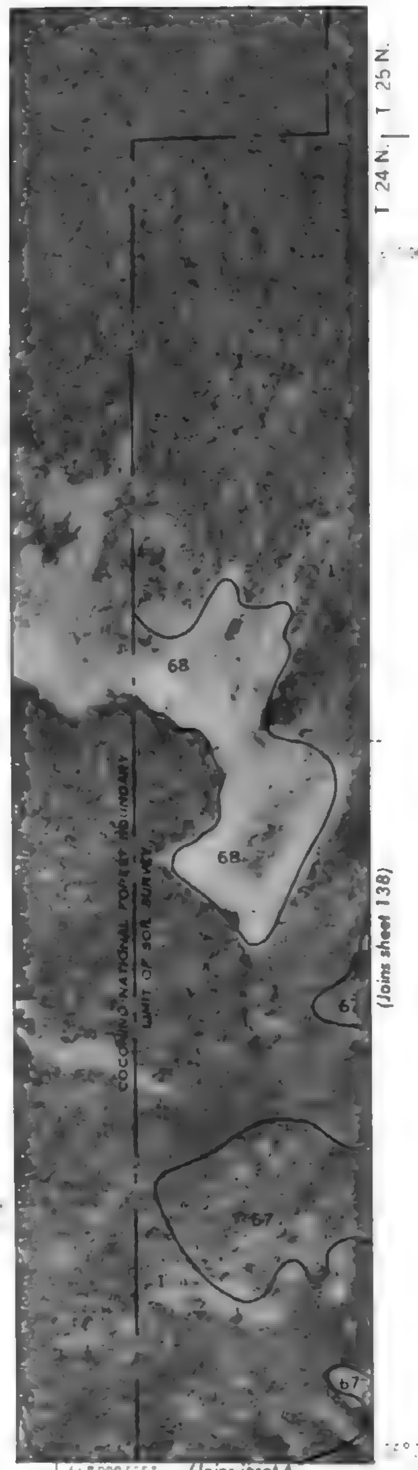
111°22'15"

R. 10 E.

(Joins sheet 128)

T. 25 N.

T. 24 N.



(Joins sheet 138)

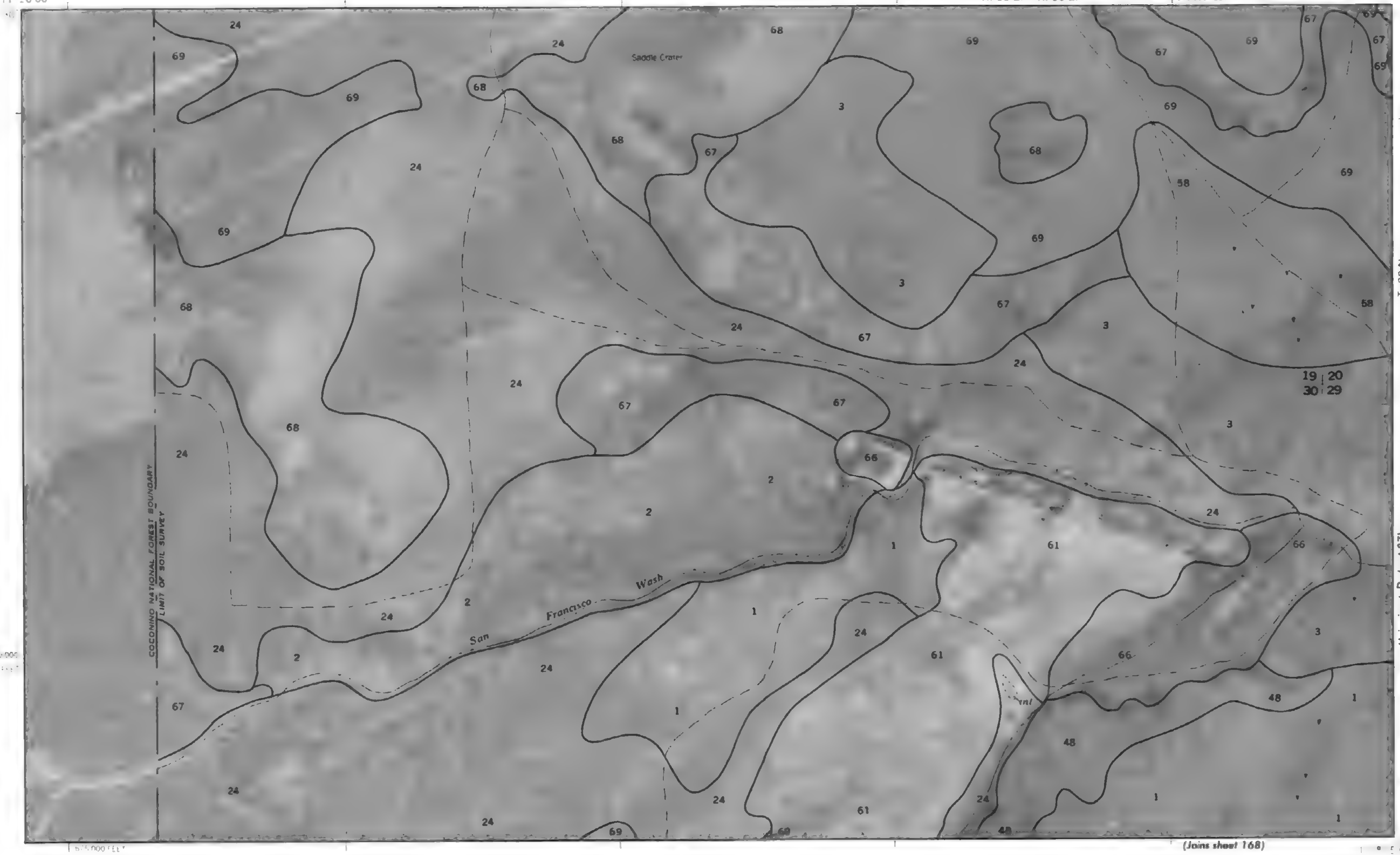
(Joins inset A, upper left)

111°22'30"

111°20'00"

R. 10 E. | R. 11 E.

(Joins sheet 165)



T. 22 N.

(Joins inset, B, sheet 87)

(Joins sheet 168)

1 ¾ ½ ¼ 0 1 2 Miles

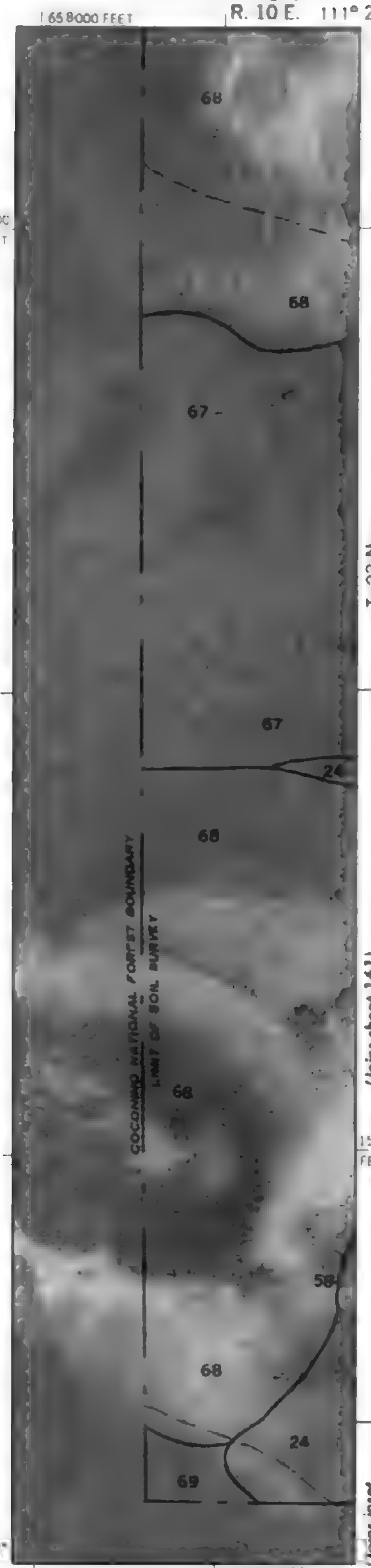
5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

COCONINO COUNTY, ARIZONA, CENTRAL PART — SHEET NUMBER 168

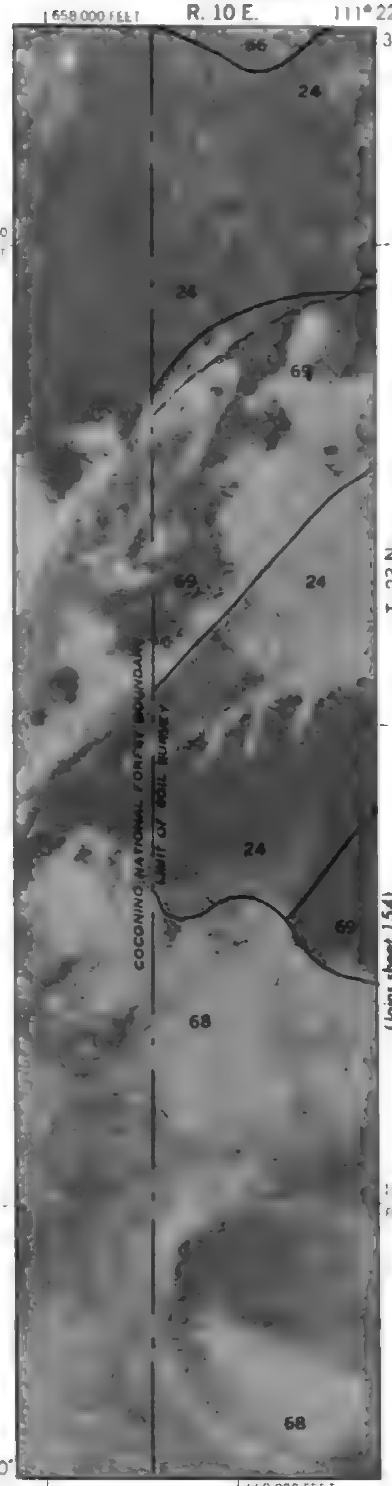
N

INSET A
(Joins inset B, lower right)

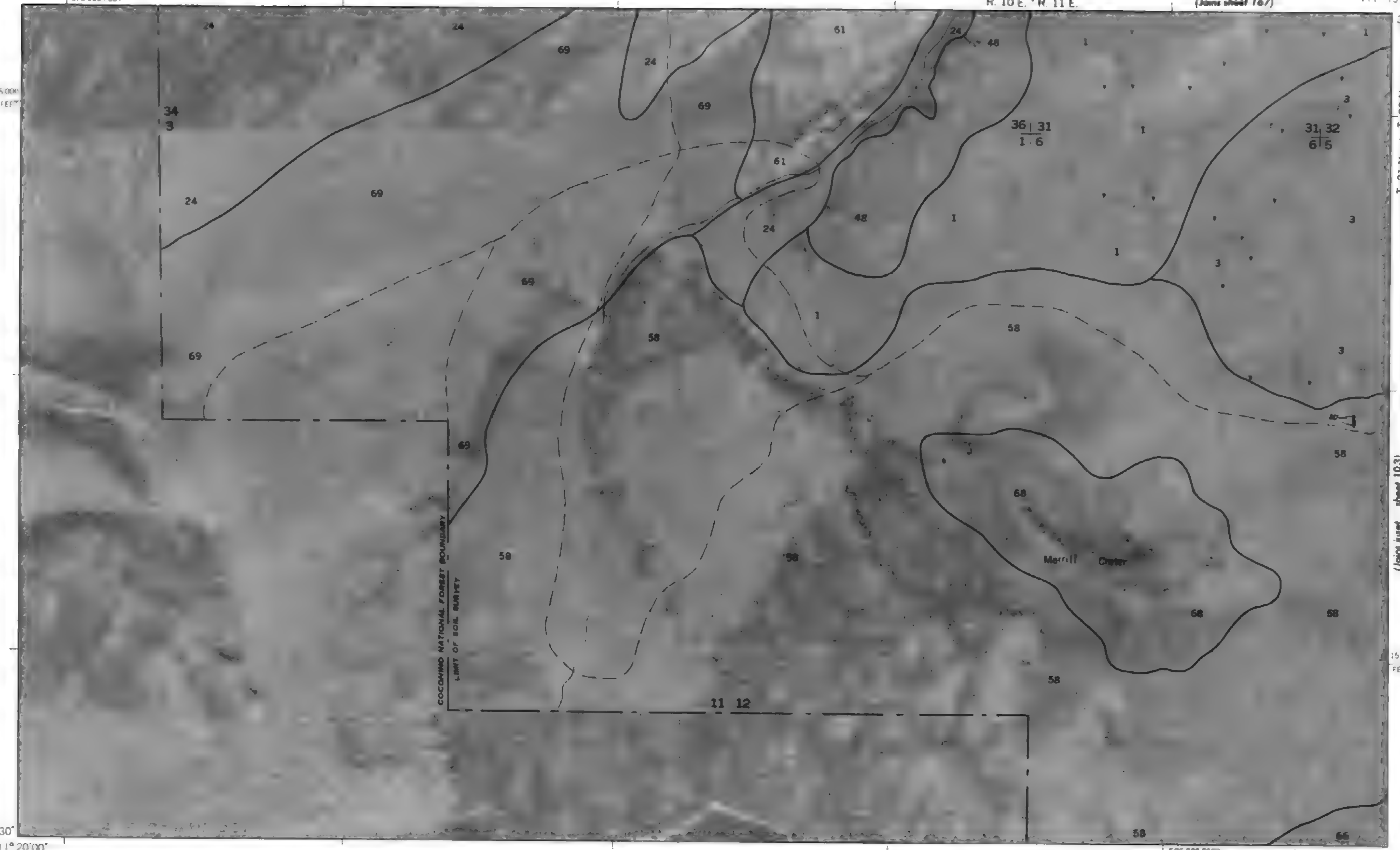


2000 AND 5000-FOOT GRID TICKS

INSET B
(Joins inset A, lower left, sheet 167)



(Joins inset, A, upper left)
2000 AND 5000-FOOT GRID TICKS



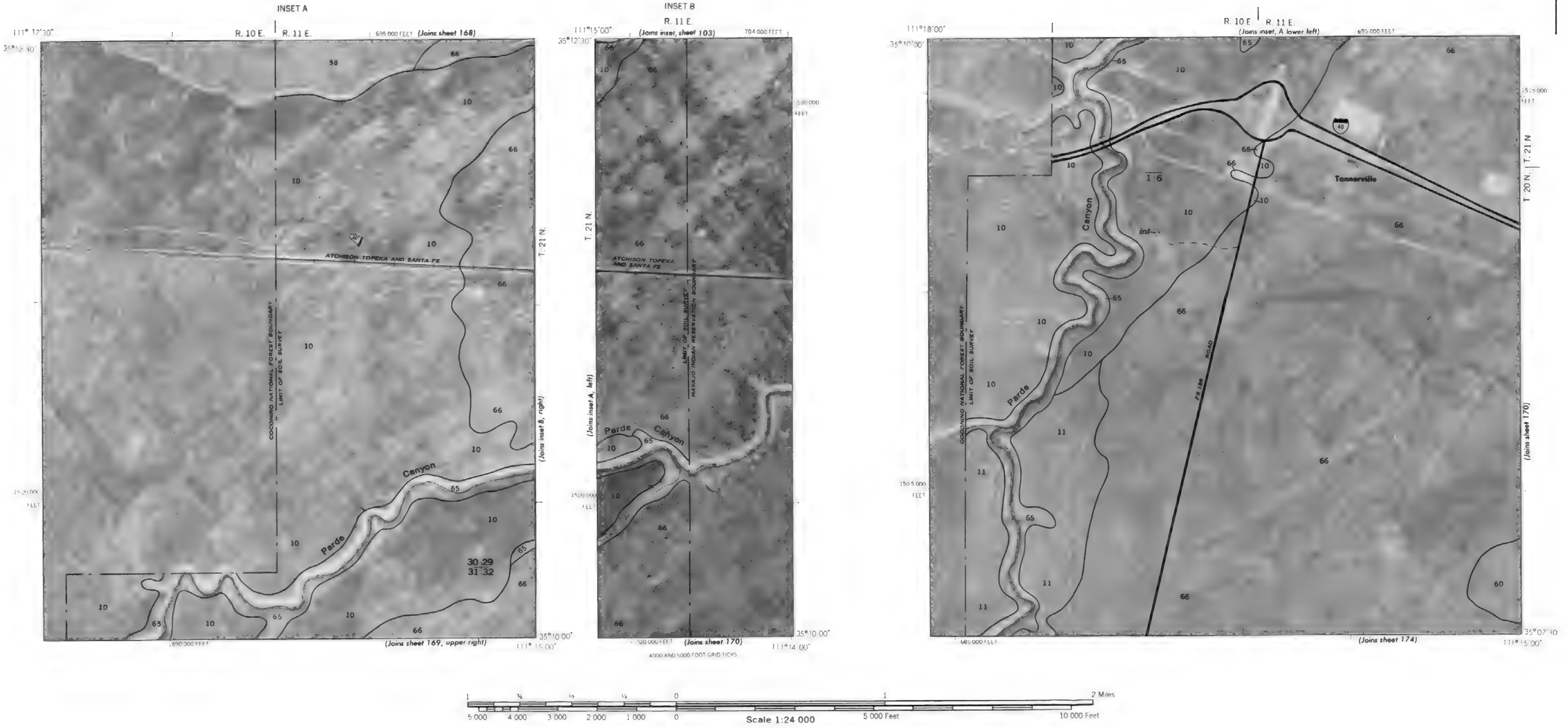
1 ¾ ½ ¼ 0 1 2 Miles
5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet
Scale 1:24 000

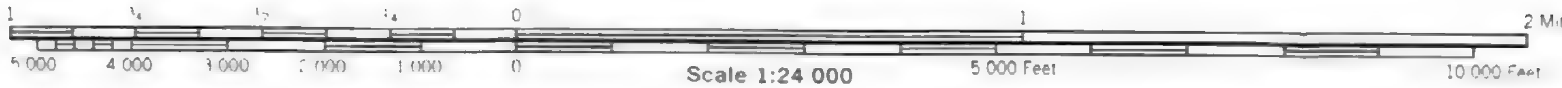
5 000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.
This map was compiled on 1972 and 1973 U.S. Department of the Interior, Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 168

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 169

This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000-foot grid ticks based on state coordinate system. Land divisions corners, if shown, are approximately positioned.

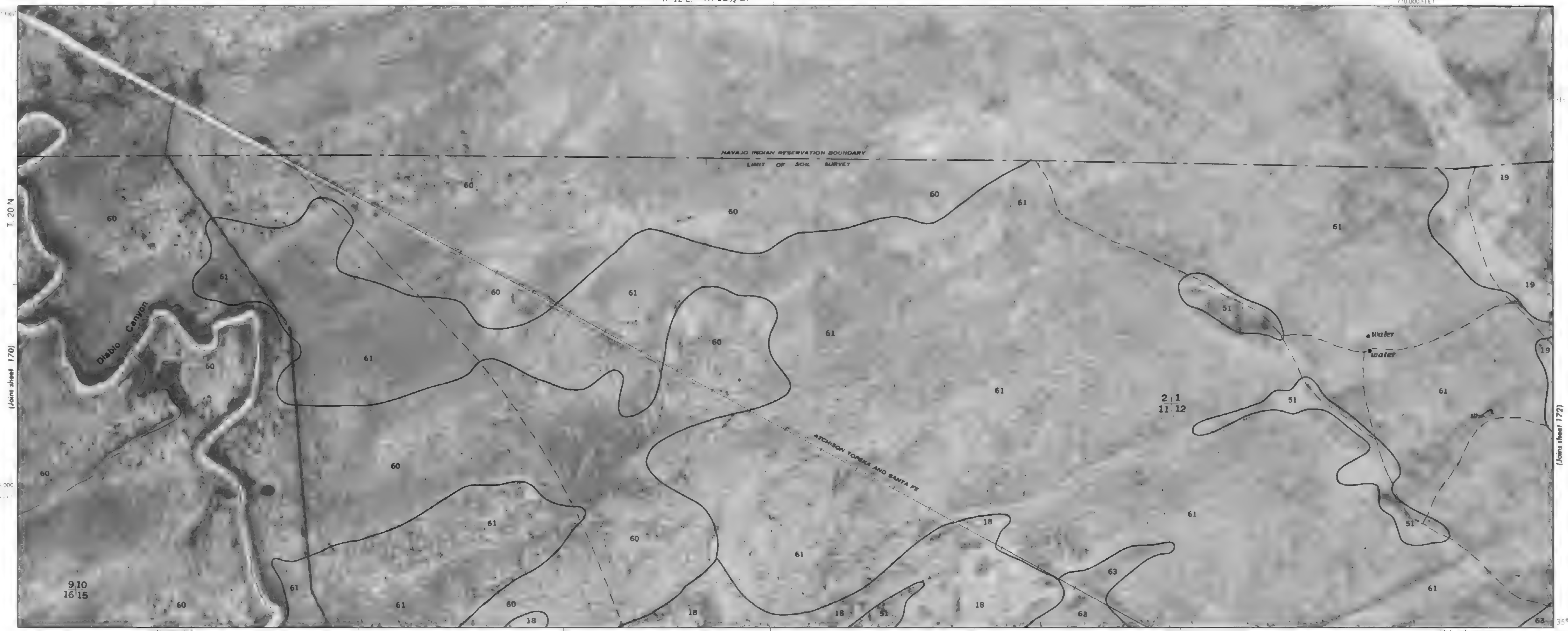




Scale 1:24 000

5,000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1977 and 1973 U.S. Department of the Interior Geological Survey orthophotography by the U.S. Department of Agriculture Soil Conservation Service and cooperating agencies.



1 ¾ ½ ¼ 0 1 2 Miles

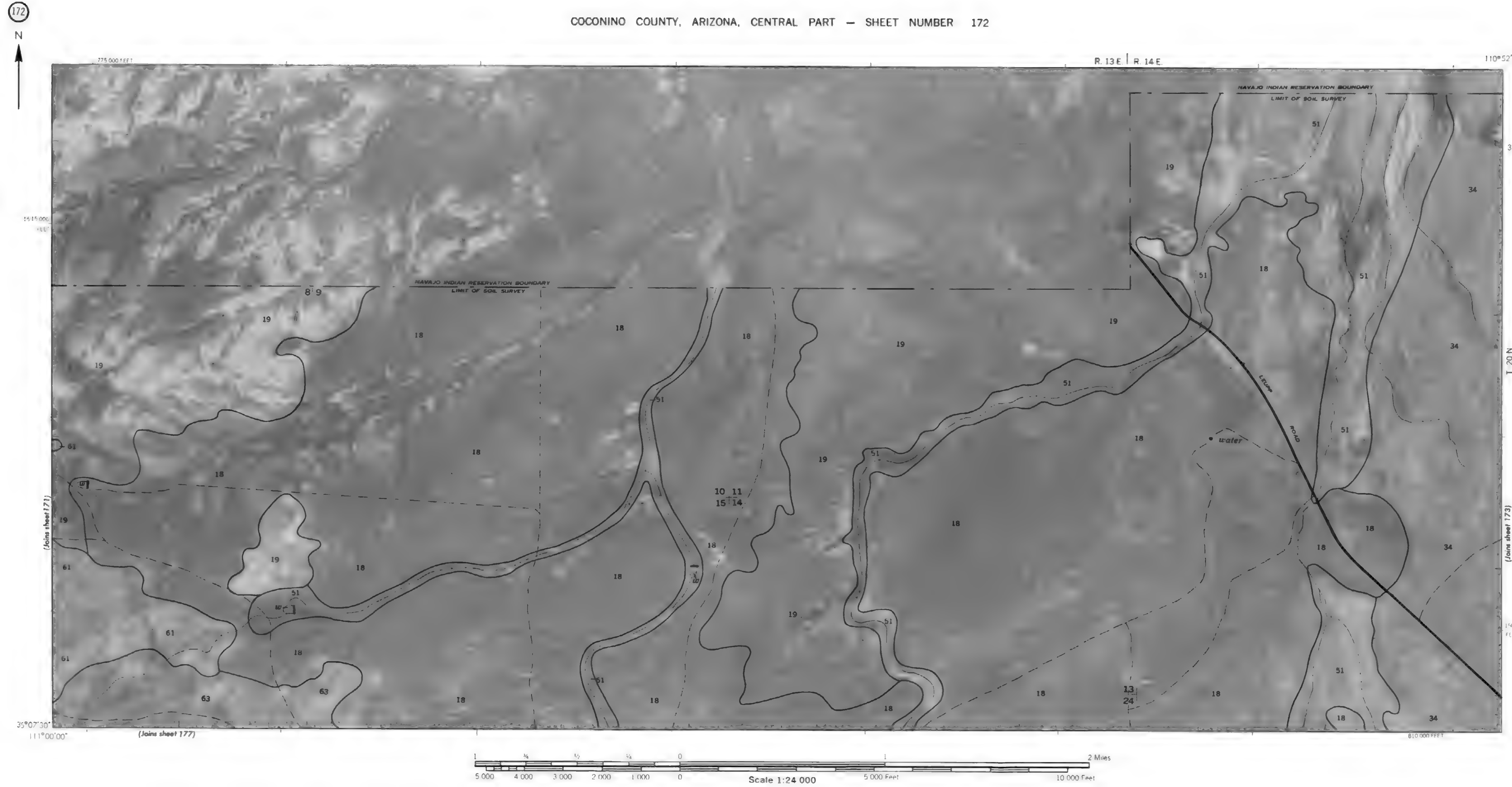
5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 171

This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotography by the U.S. Department of Agriculture Soil Conservation Service and cooperating agencies.
5,000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

COCONINO COUNTY, ARIZONA, CENTRAL PART — SHEET NUMBER 172

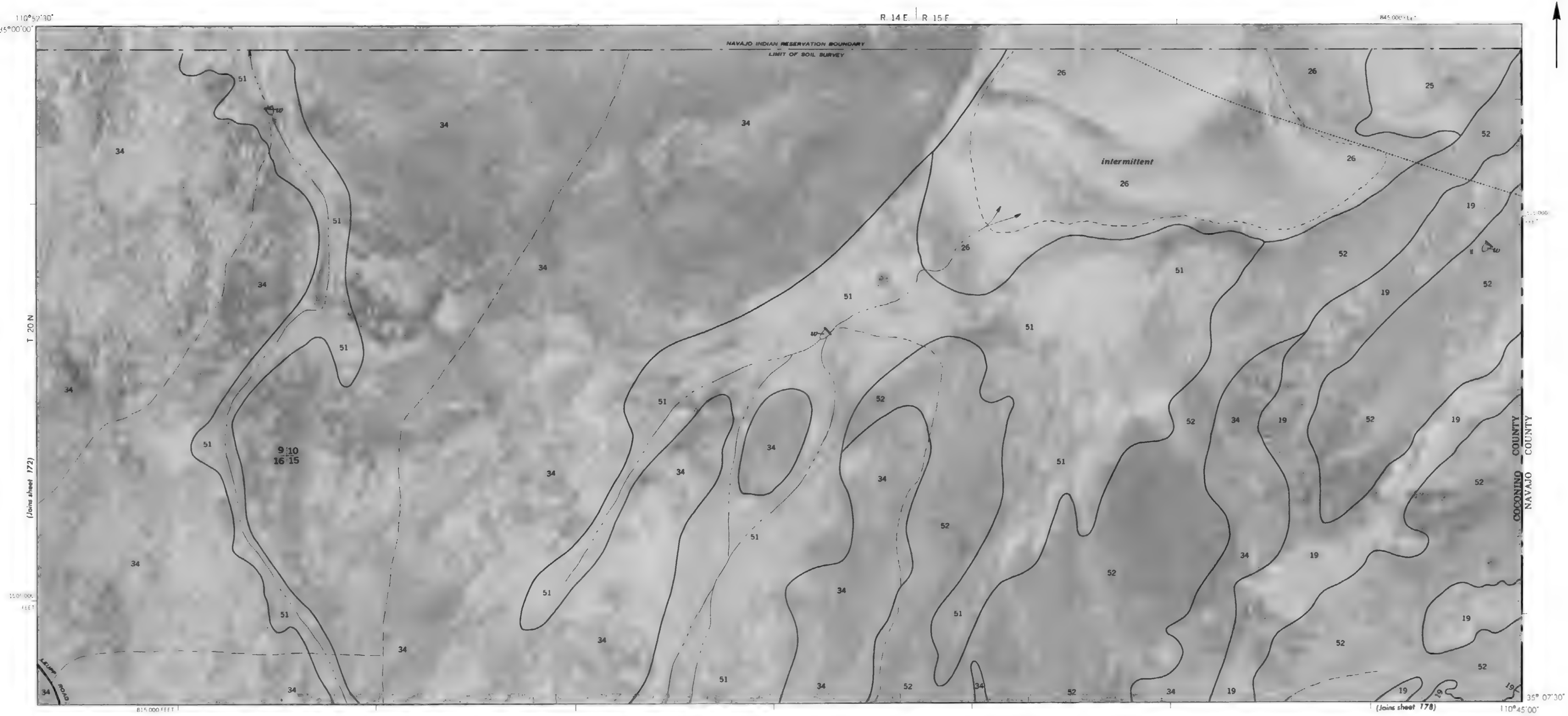


This map was compiled on 1972 and 1973 U.S. Department of the Interior, Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 172

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 173

This map was compiled on 1972 and 1973 U.S. Department of The Interior, Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies
5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned



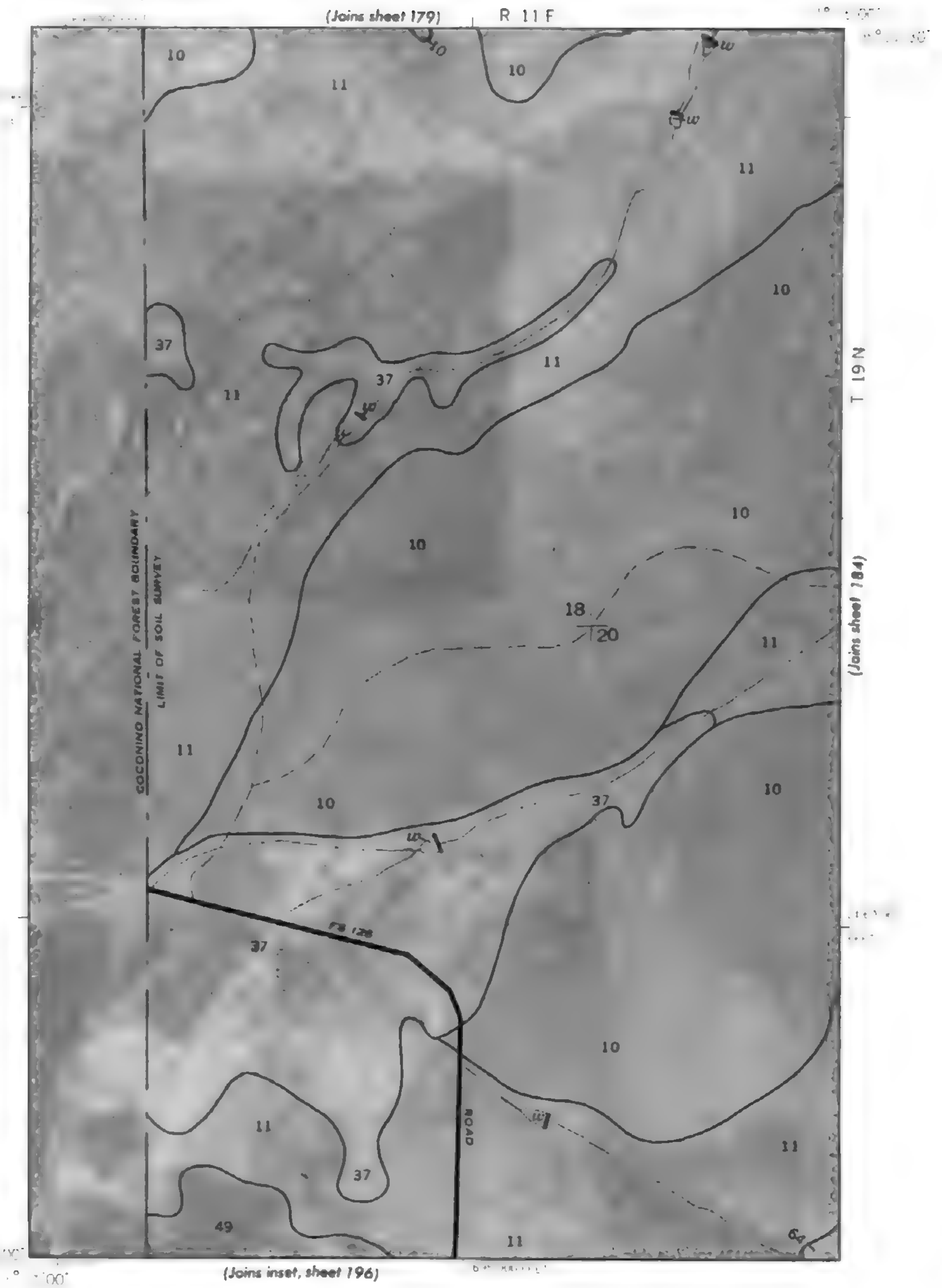
Scale 1:24 000

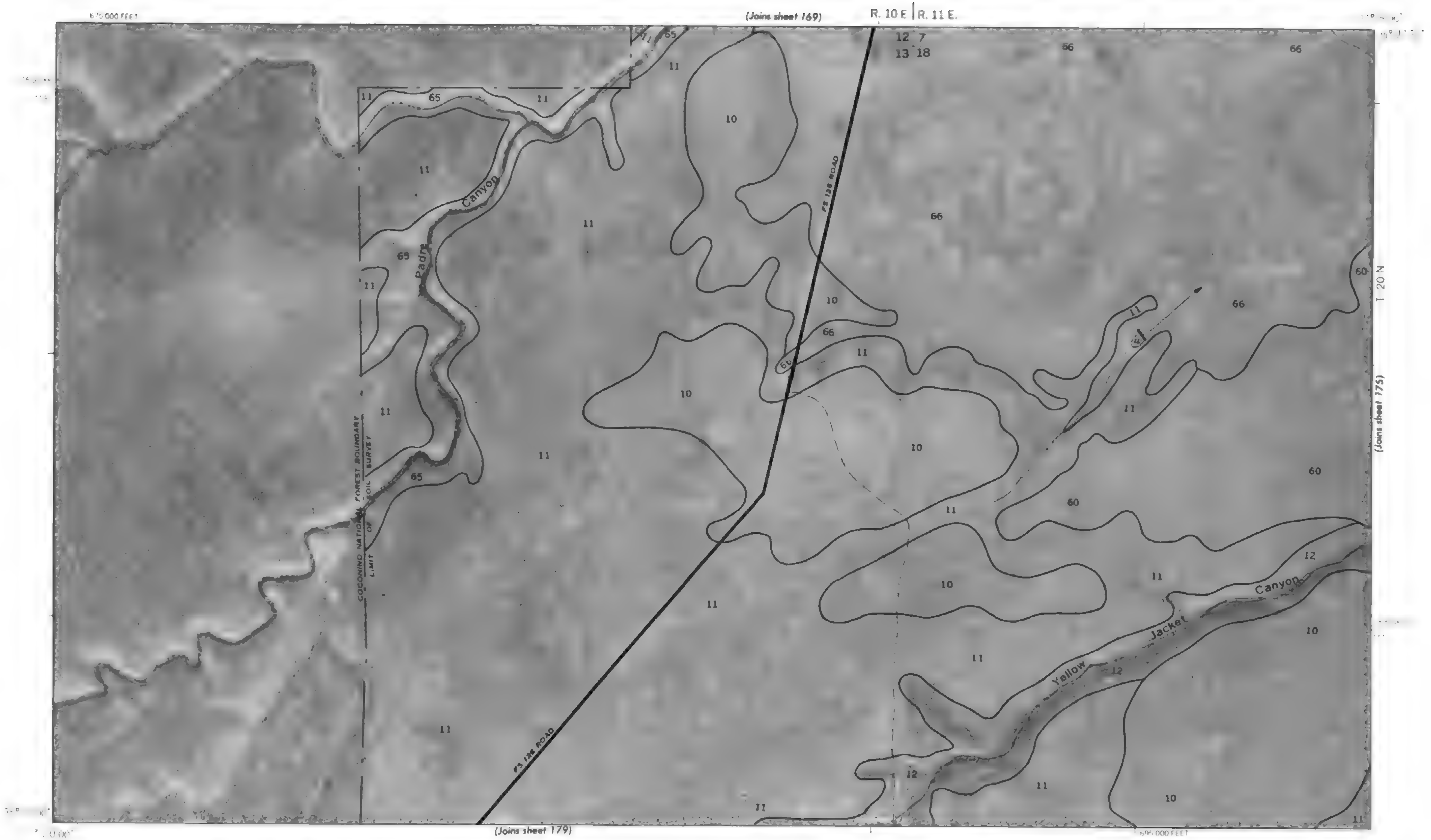
1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

N

INSET



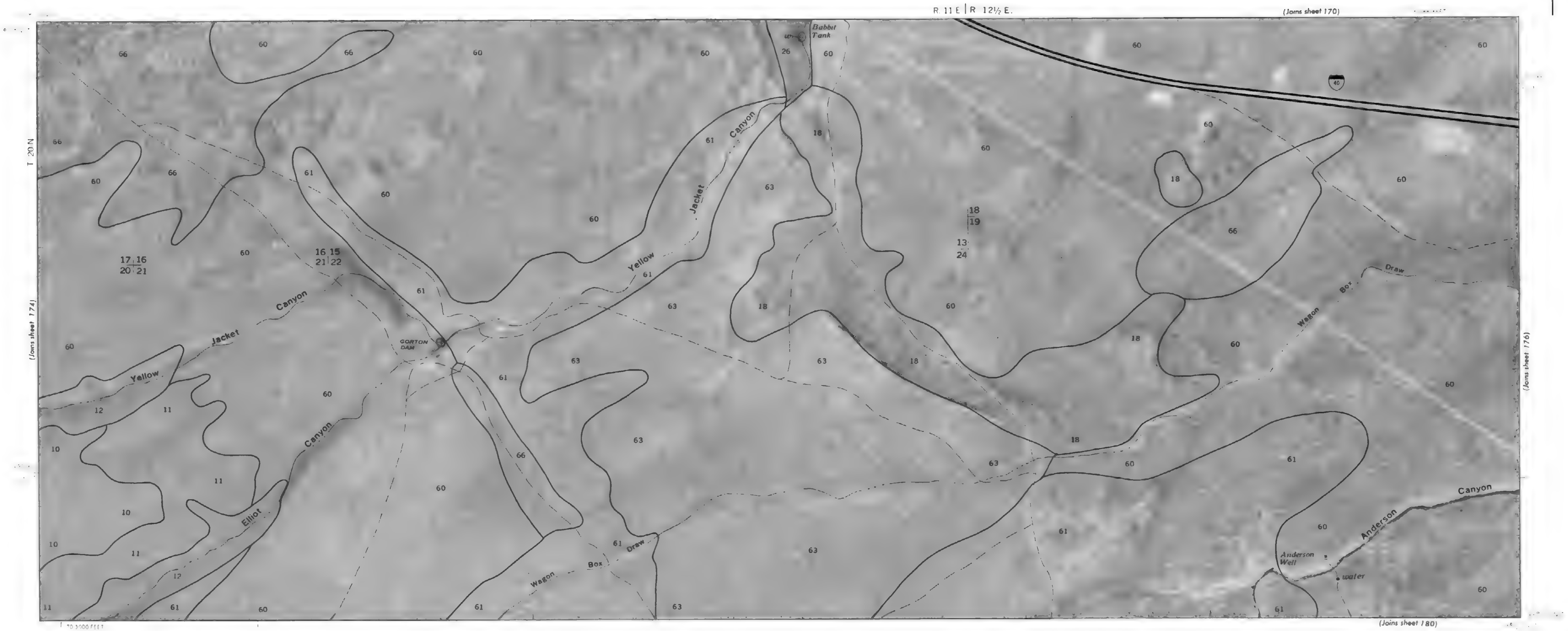


1 ¾ ½ ¼ 0 1 2 Miles
5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet
Scale 1:24 000

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 174

175

N

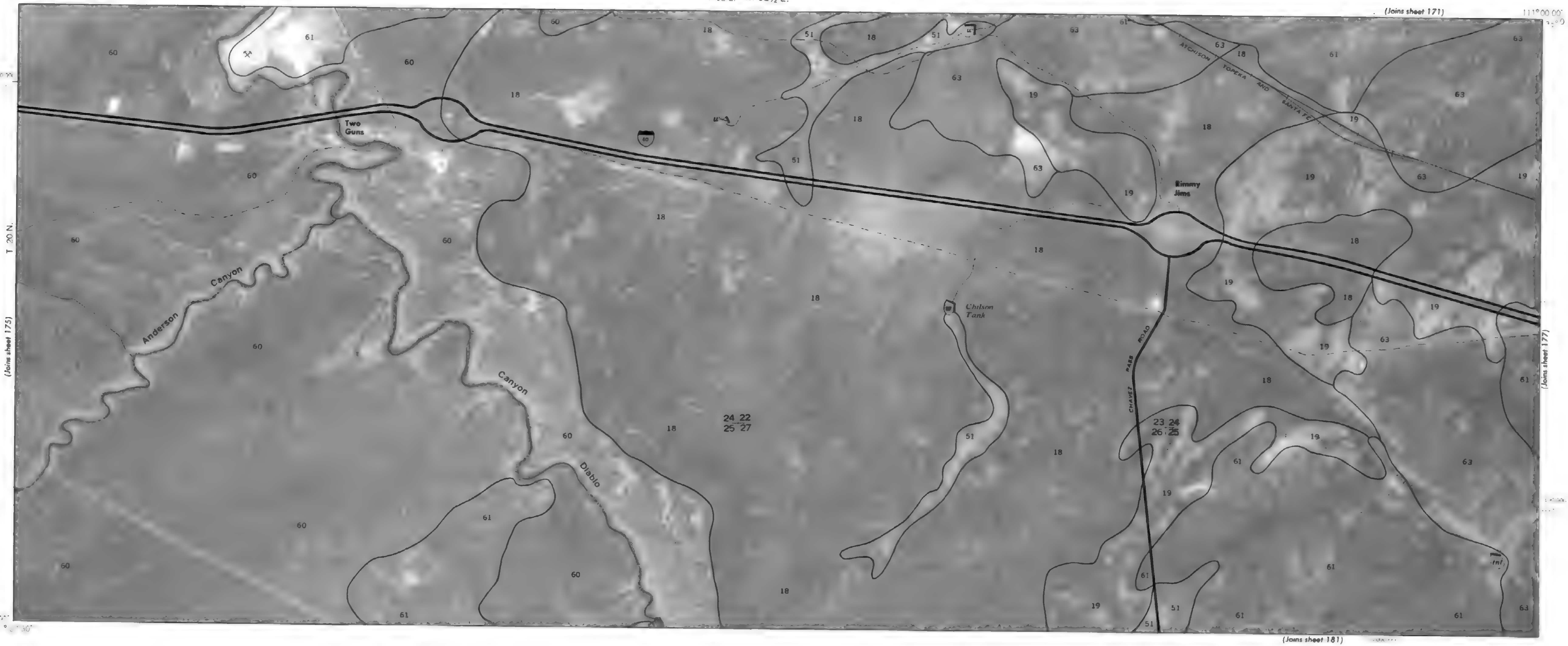


Scale 1:24 000

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 175

COCONINO COUNTY, ARIZONA, CENTRAL PART — SHEET NUMBER 176

N

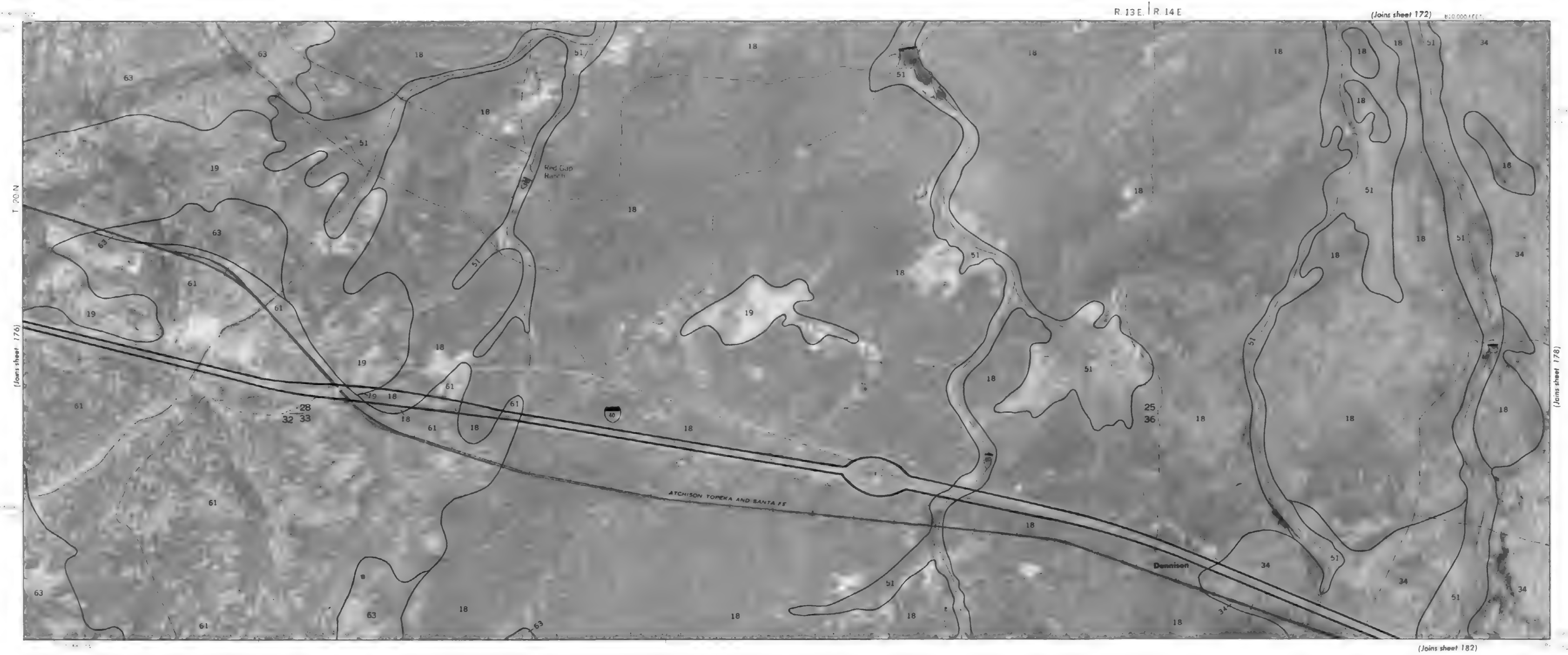


1 ¾ ½ ¼ 0 1 2 Miles
5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet
Scale 1:24 000

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 176

177

N



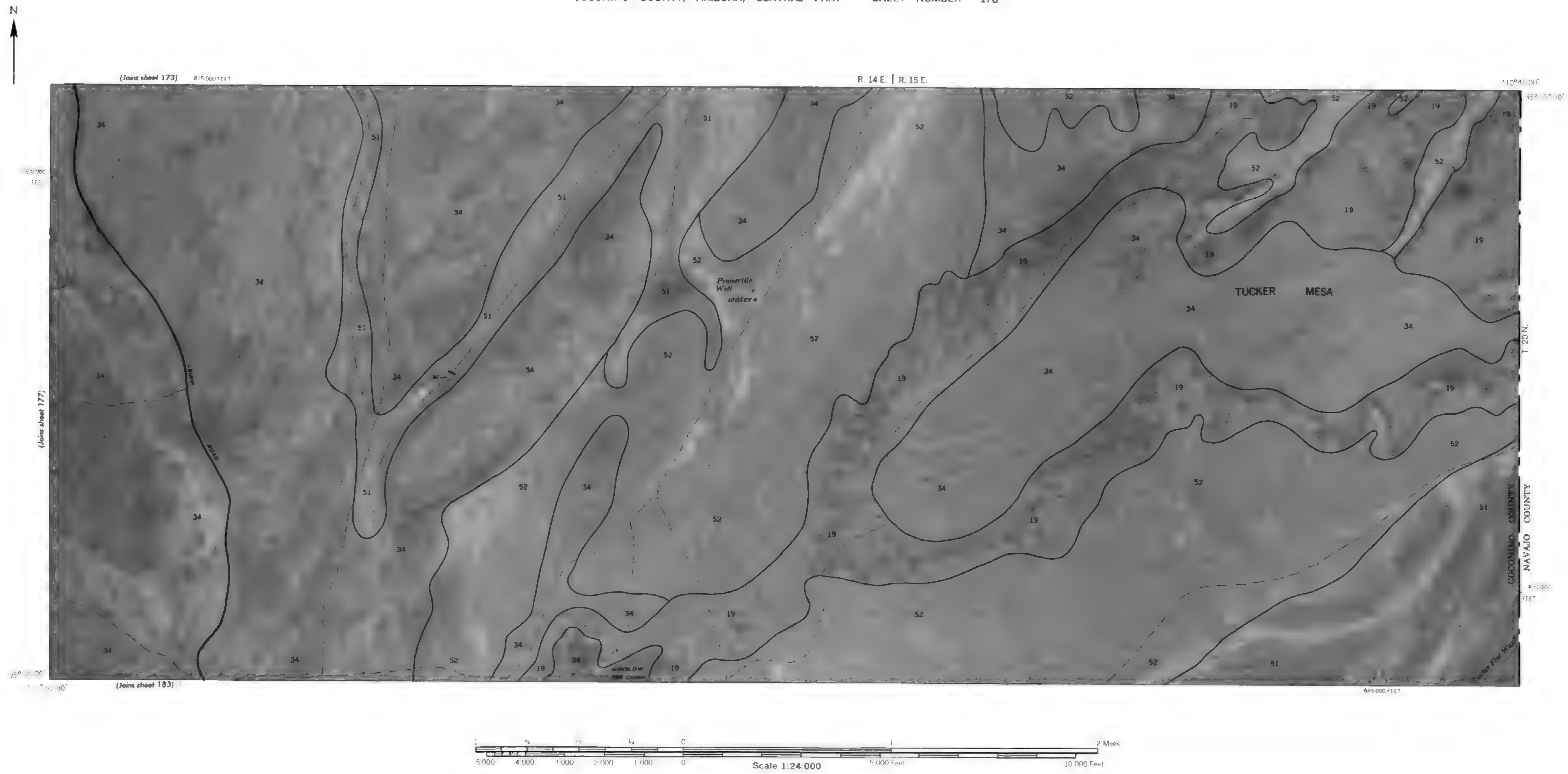
5,000 4,000 3,000 2,000 1,000 0 5,000 Feet 10,000 Feet

Scale 1:24 000

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 177

This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

COCONINO COUNTY, ARIZONA, CENTRAL PART — SHEET NUMBER 178

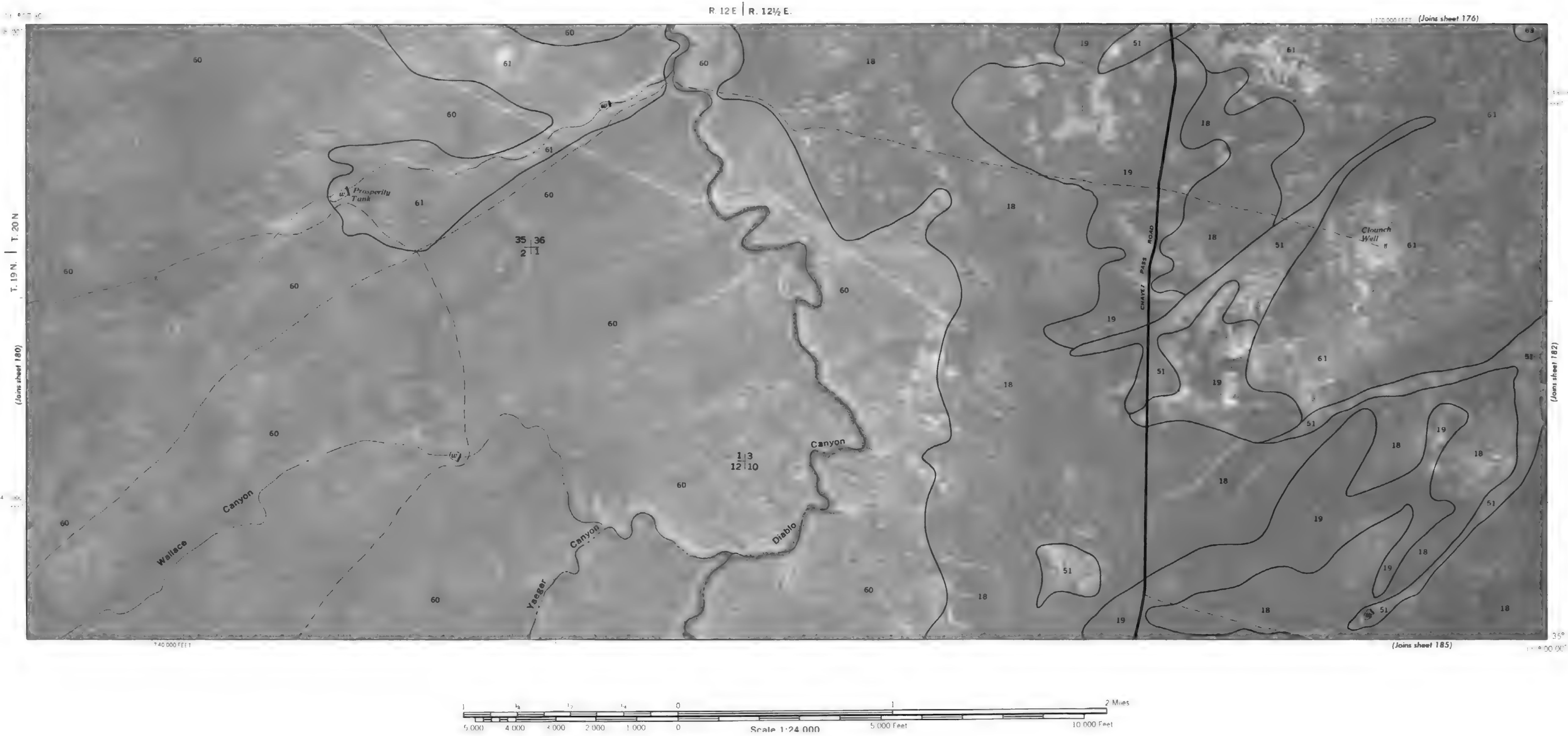


5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned

This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotography by the U.S. Department of Agriculture Soil Conservation Service and cooperating agencies

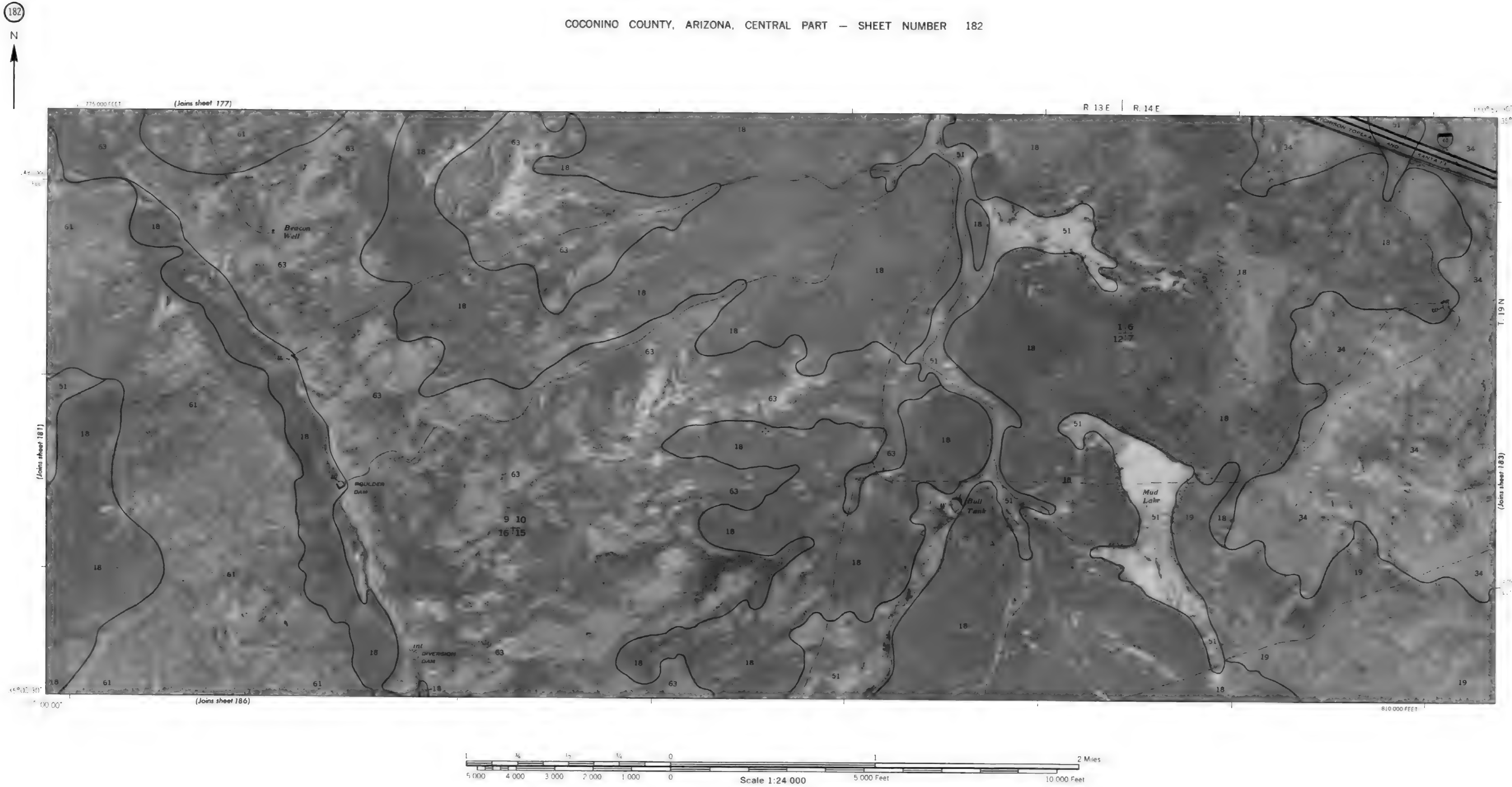
COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 179


180
N
(Joins sheet 175)
(Joins sheet 179)
(Joins sheet 181)
(Joins sheet 184)
R. 11 E. | R. 12 E.
T. 20 N. | T. 19 N.
Elliot Canyon
Wagon Box Draw
Sinkhole Tank
Anderson Canyon
Big Anderson Tank
Boyd Reid Tank
Lute Hart Tank
Scale 1:24 000
2 Miles
5 000 Feet
10 000 Feet



COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 181

This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.



This map was compiled on 1972 and 1973 U S Department of The Interior Geological Survey orthophotography by the U S Department of Agriculture Soil Conservation Service and cooperating agencies

5,000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 182

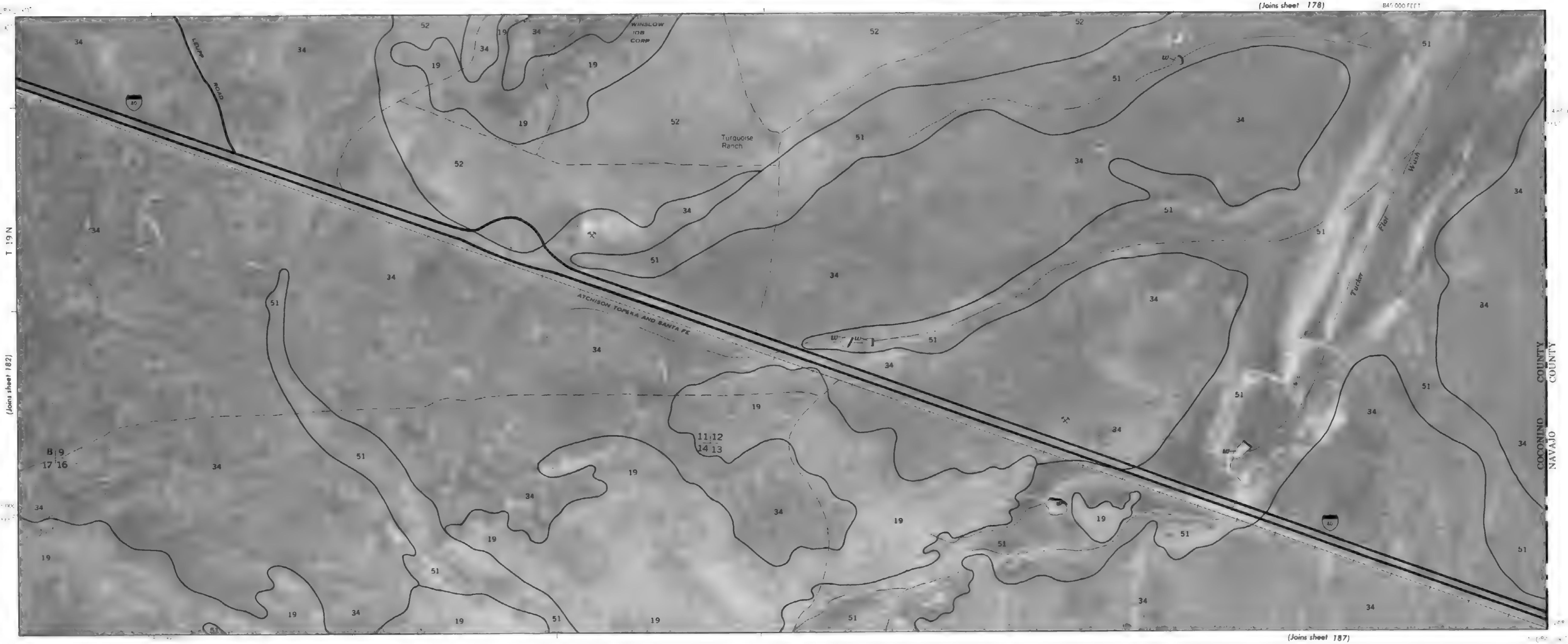
N

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 183

This map was compiled on 1972 and 1973 U.S. Department of the Interior, Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000-foot grid ticks based on state coordinate system. Land division corners if shown are approximately positioned.

R. 14 E. | R. 15 E.

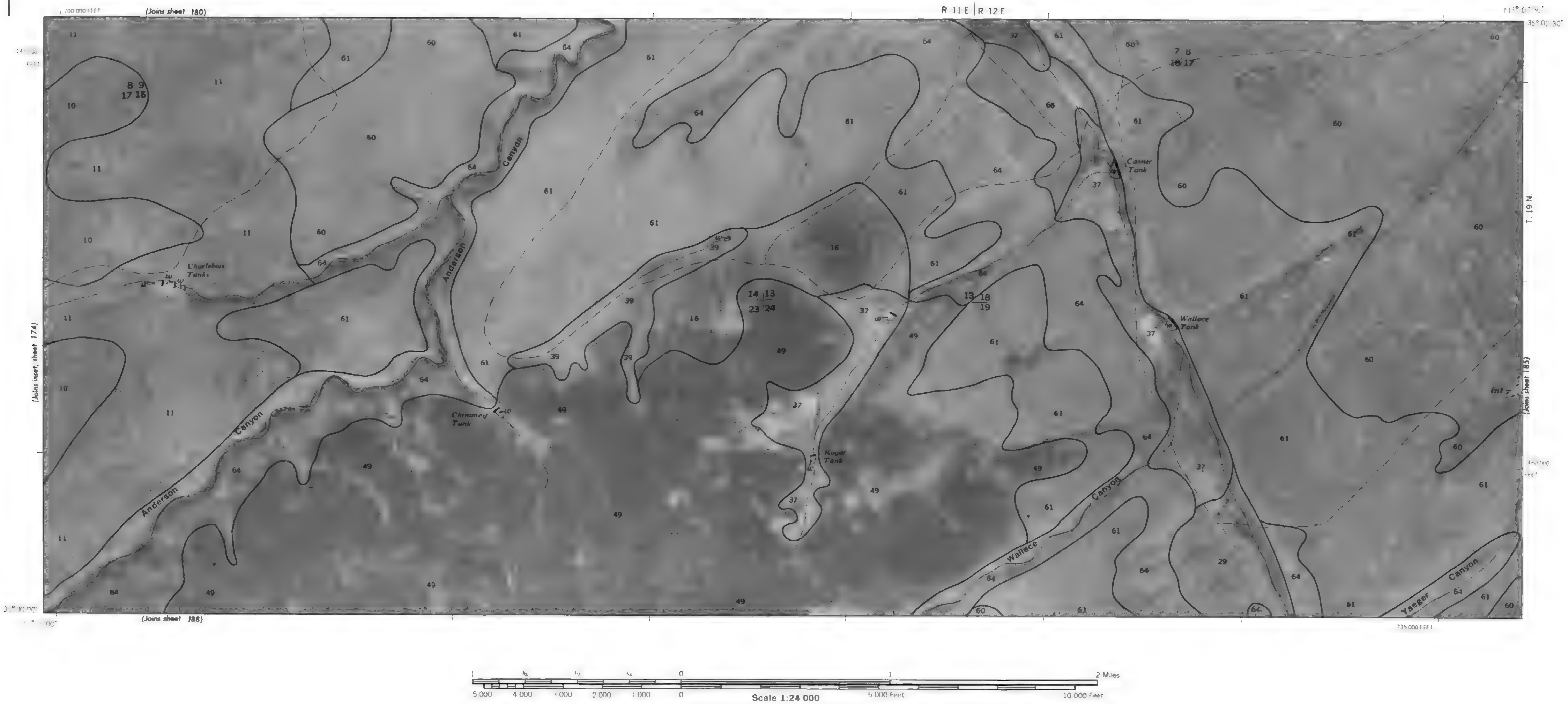
(Joins sheet 178)



1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000



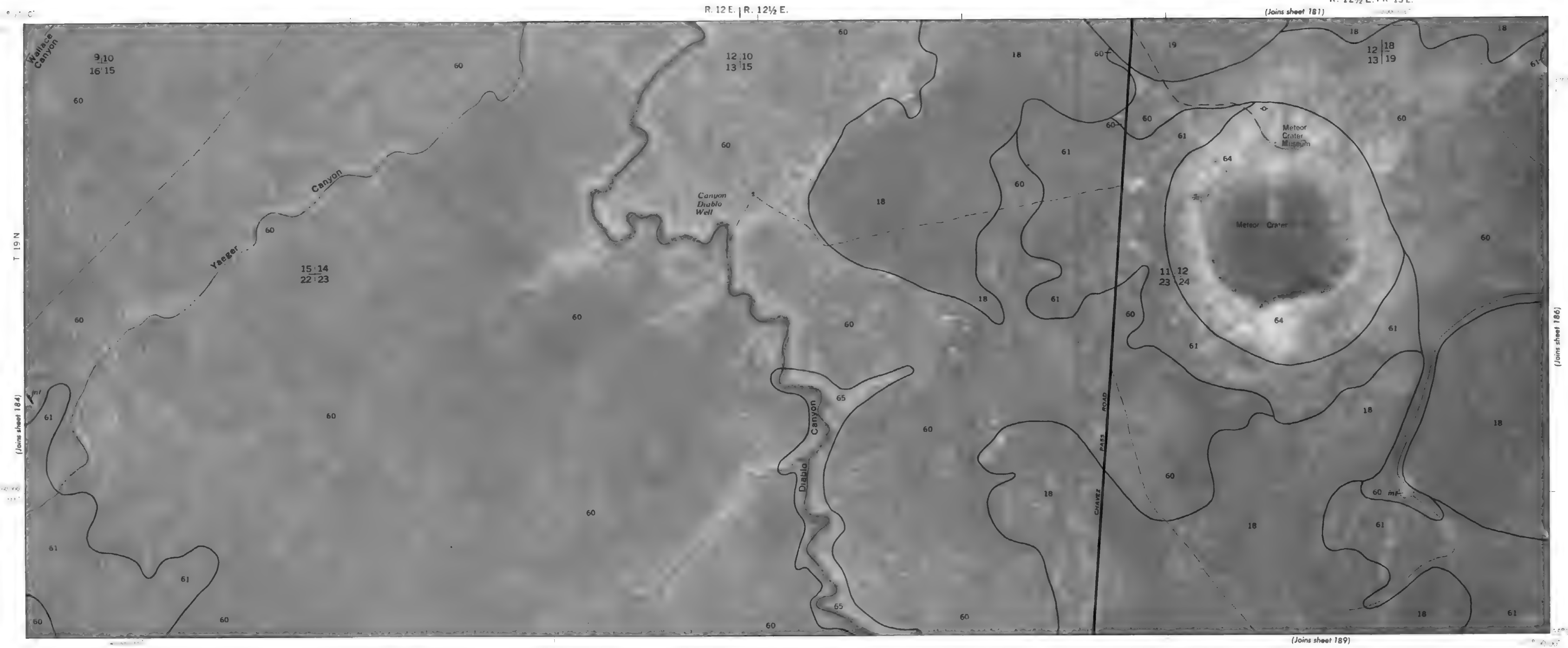
COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 184

185

N

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 185

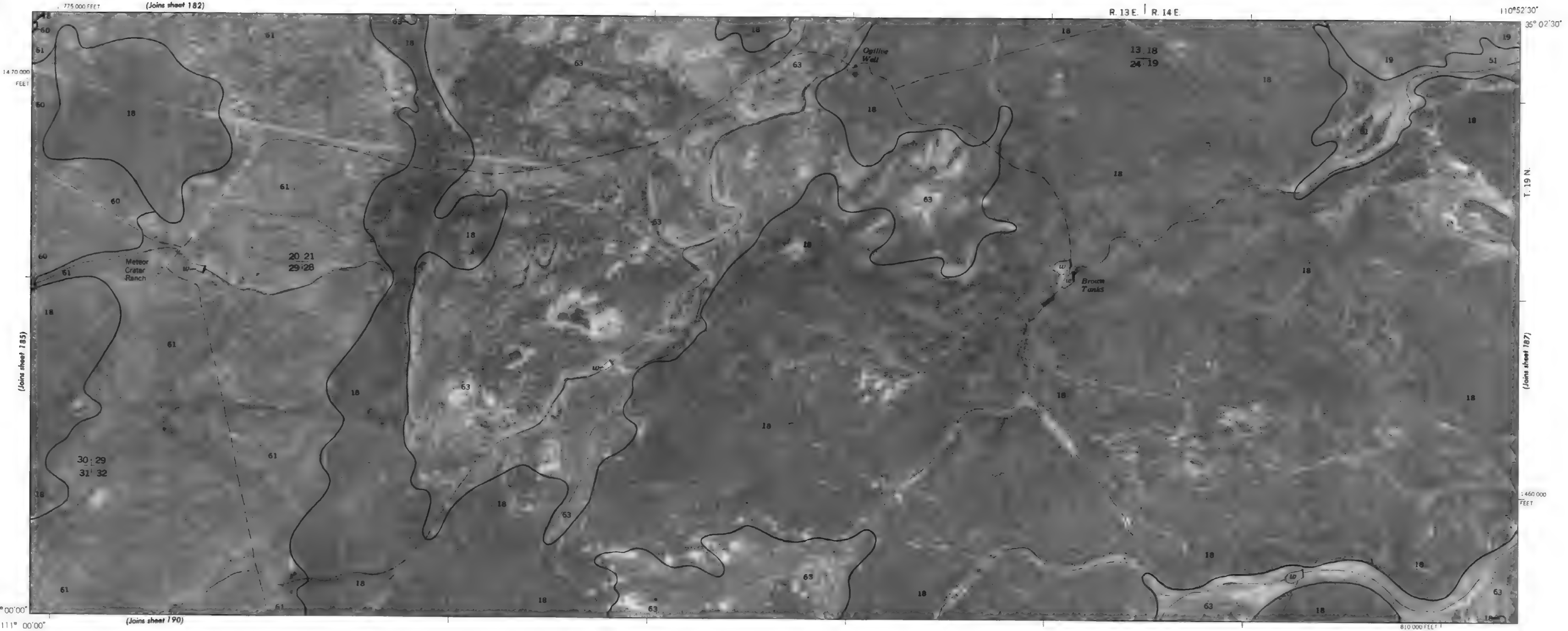
This map was compiled on 1972 and 1973 U.S. Department of the Interior, Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000 foot grid ticks based on state coordinate system. Land division corners if shown are approximately positioned.



Scale 1:24 000

N

COCONINO COUNTY, ARIZONA, CENTRAL PART — SHEET NUMBER 186



1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

5 000 foot grid ticks based on state coordinate system. Land division corners if shown are approximately positioned.

This map was compiled on 1972 and 1973 U S Department of the Interior Geological Survey orthophotography by the U S Department of Agriculture Soil Conservation Service and cooperating agencies

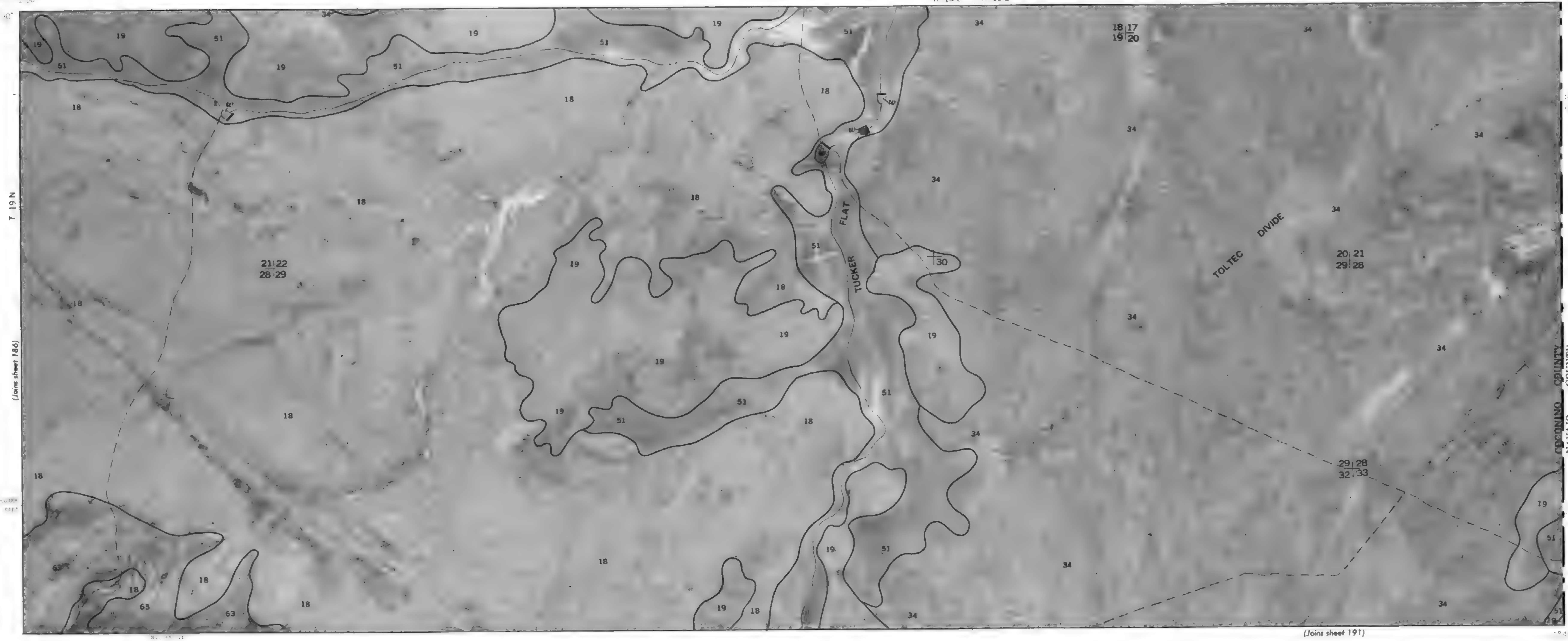
COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 186

187

N

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 187

This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotographs by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. 5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.



Scale 1:24 000

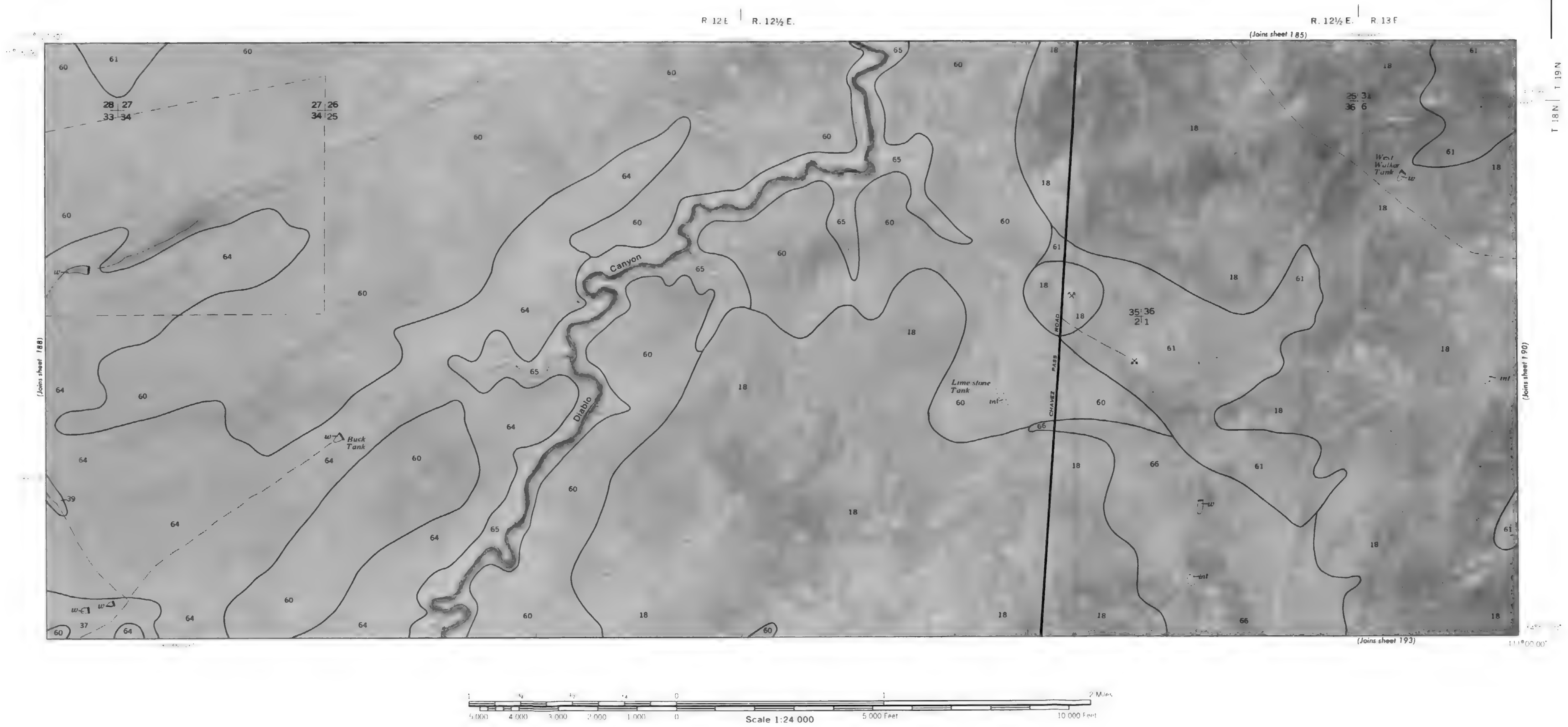
1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

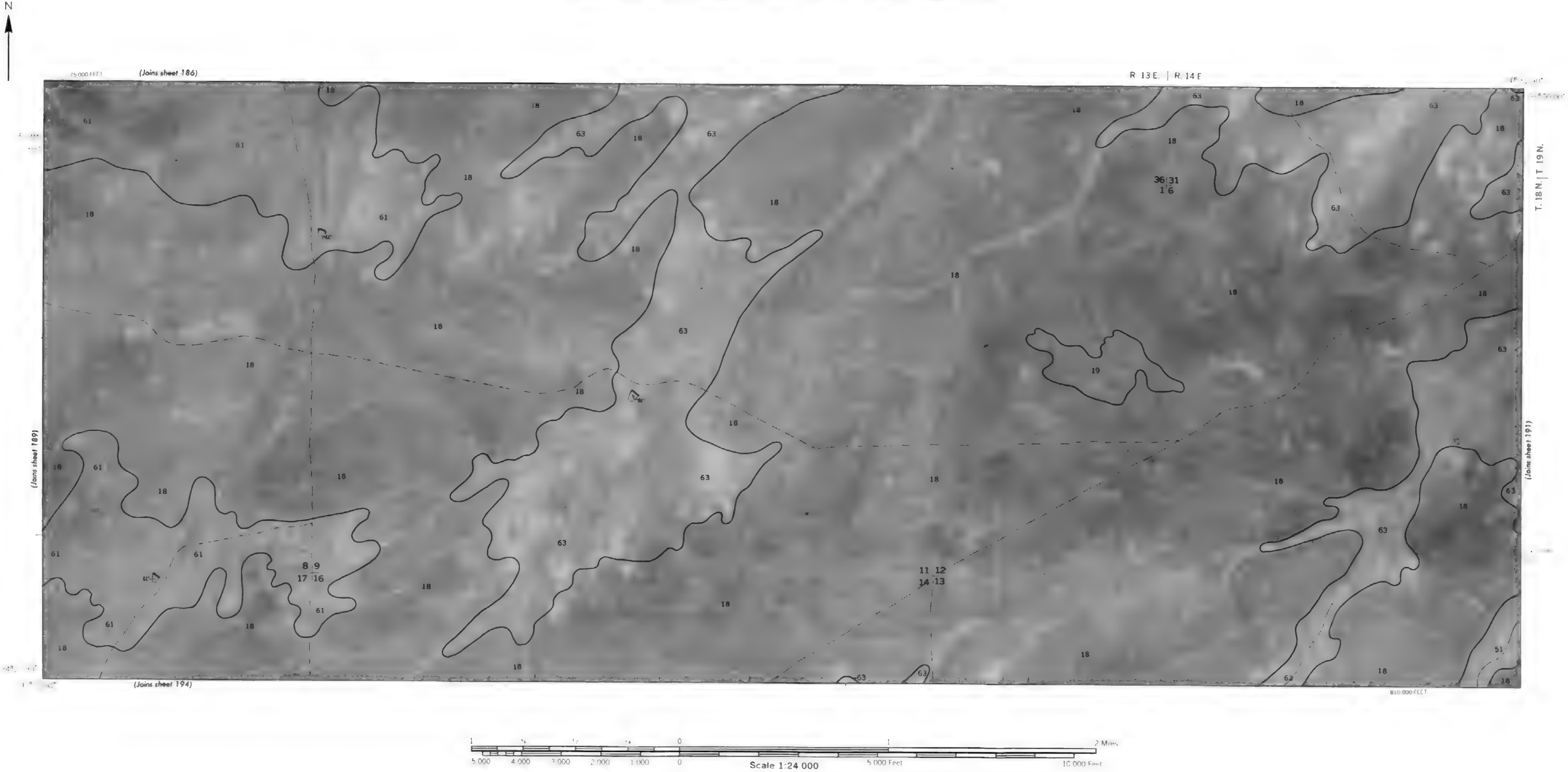
COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 188



COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 189

This map was compiled on 1972 and 1973 U.S. Department of the Interior, Geological Survey orthophotographs by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. 5,000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

COCONINO COUNTY, ARIZONA, CENTRAL PART — SHEET NUMBER 190



Scale 1:24 000

5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1972 and 1973 U.S. Department of the Interior, Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

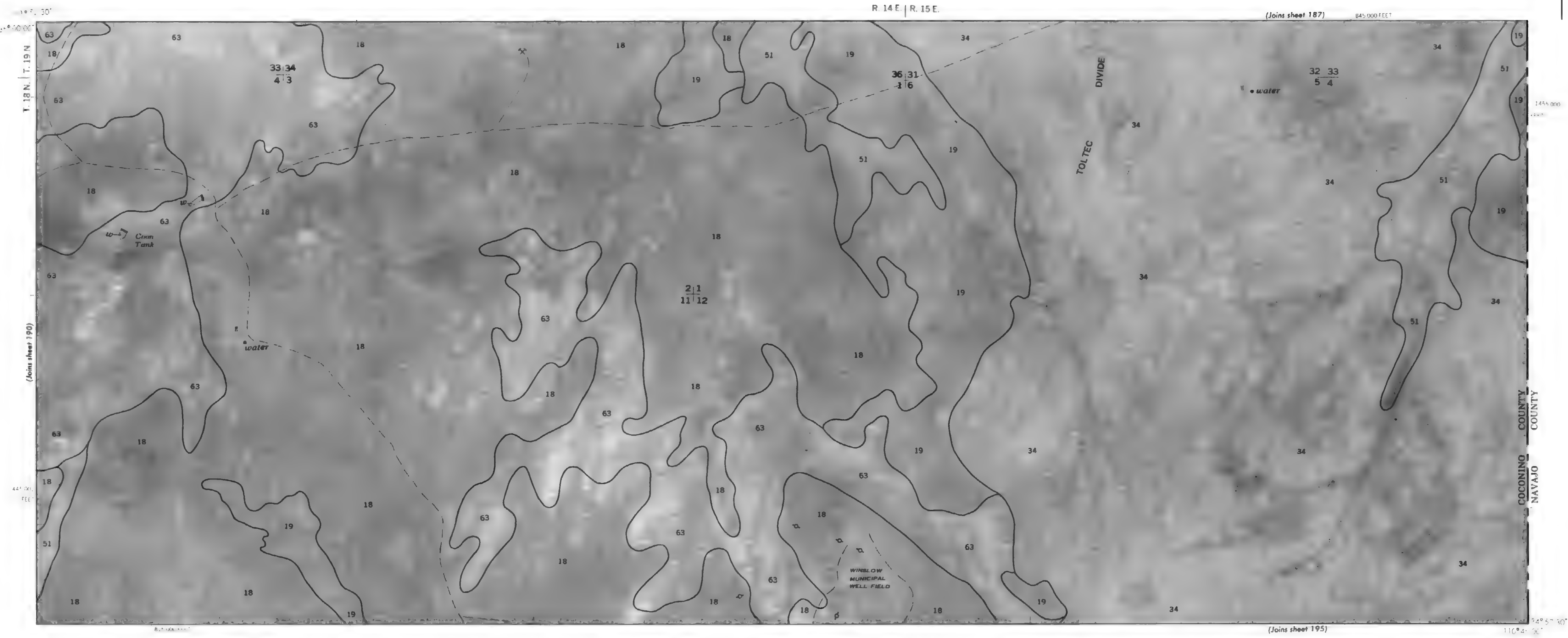
COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 190

191

N

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 191

This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotographs by the U.S. Department of Agriculture Soil Conservation Service and cooperating agencies. 5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.



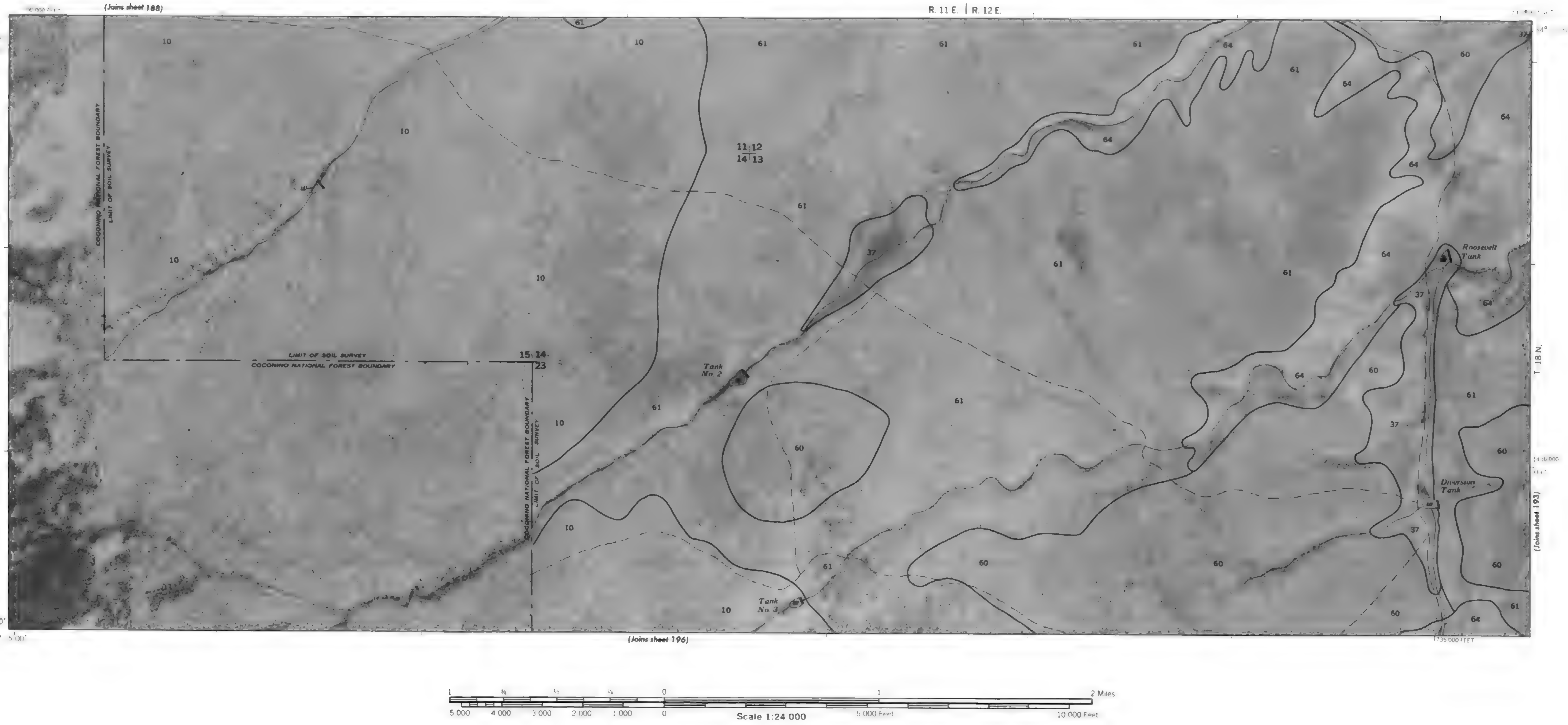
Scale 1:24 000

1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

COCONINO COUNTY, ARIZONA, CENTRAL PART — SHEET NUMBER 192

N

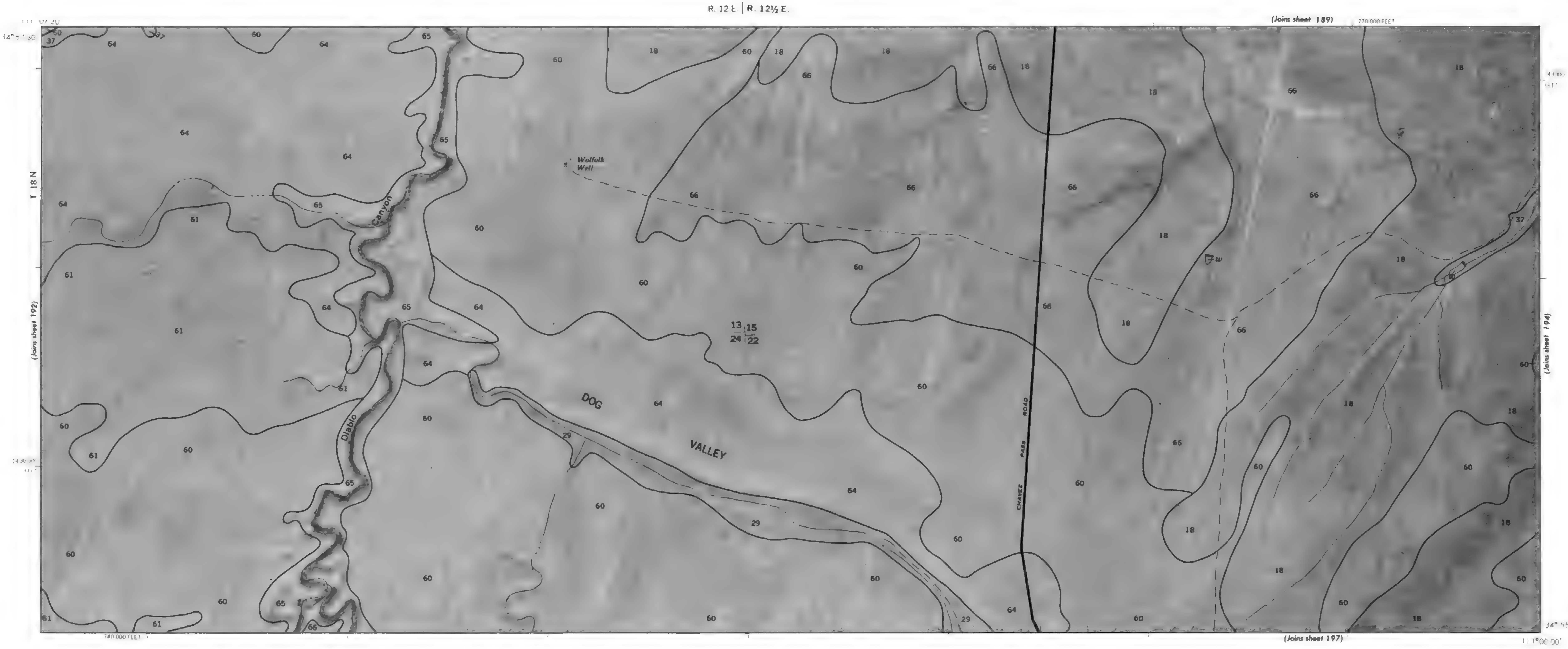


5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.
This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 192

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 193

This map was compiled on 1972 and 1973 U.S. Department of the Interior, Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. 5,000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

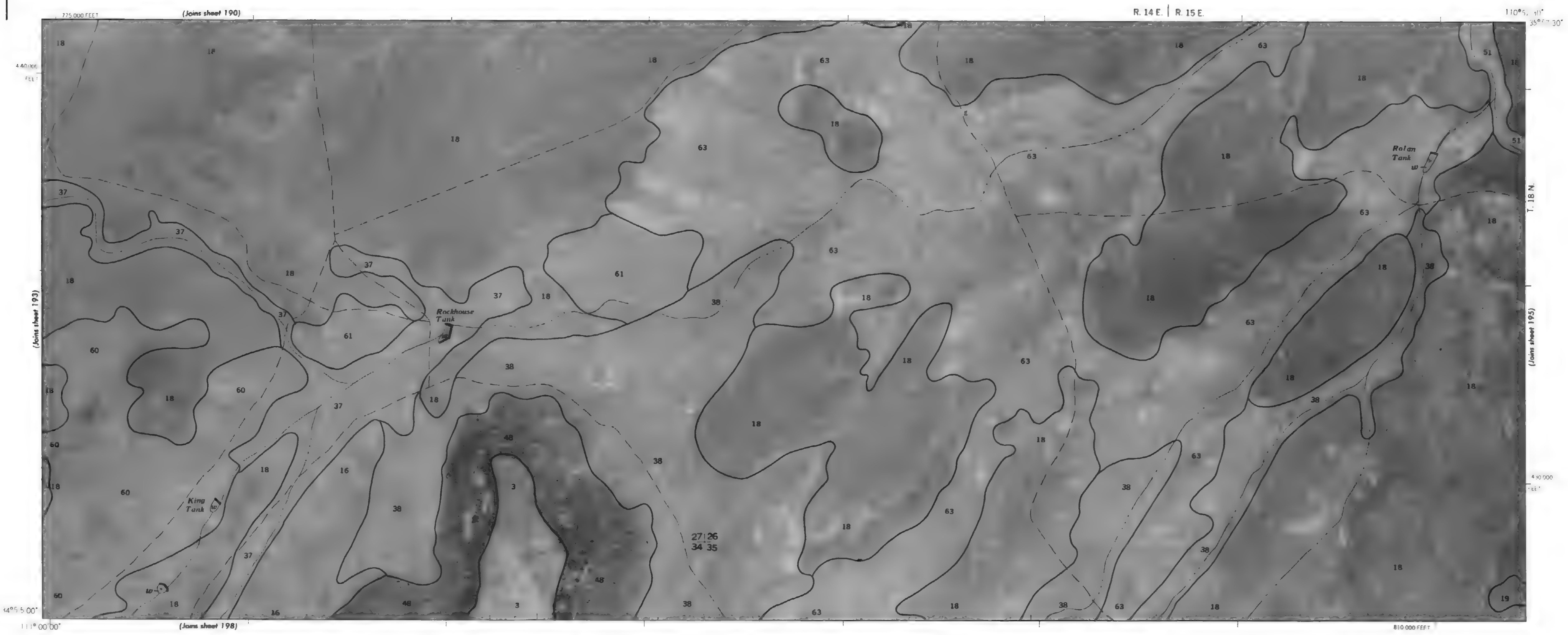


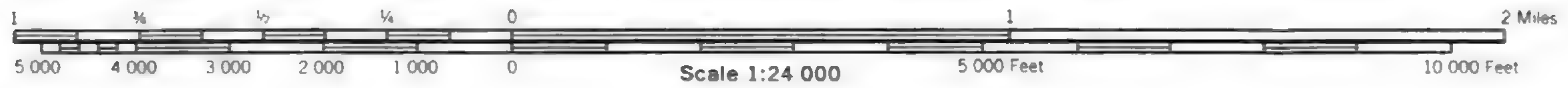
Scale 1:24 000

1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

COCONINO COUNTY, ARIZONA, CENTRAL PART — SHEET NUMBER 194

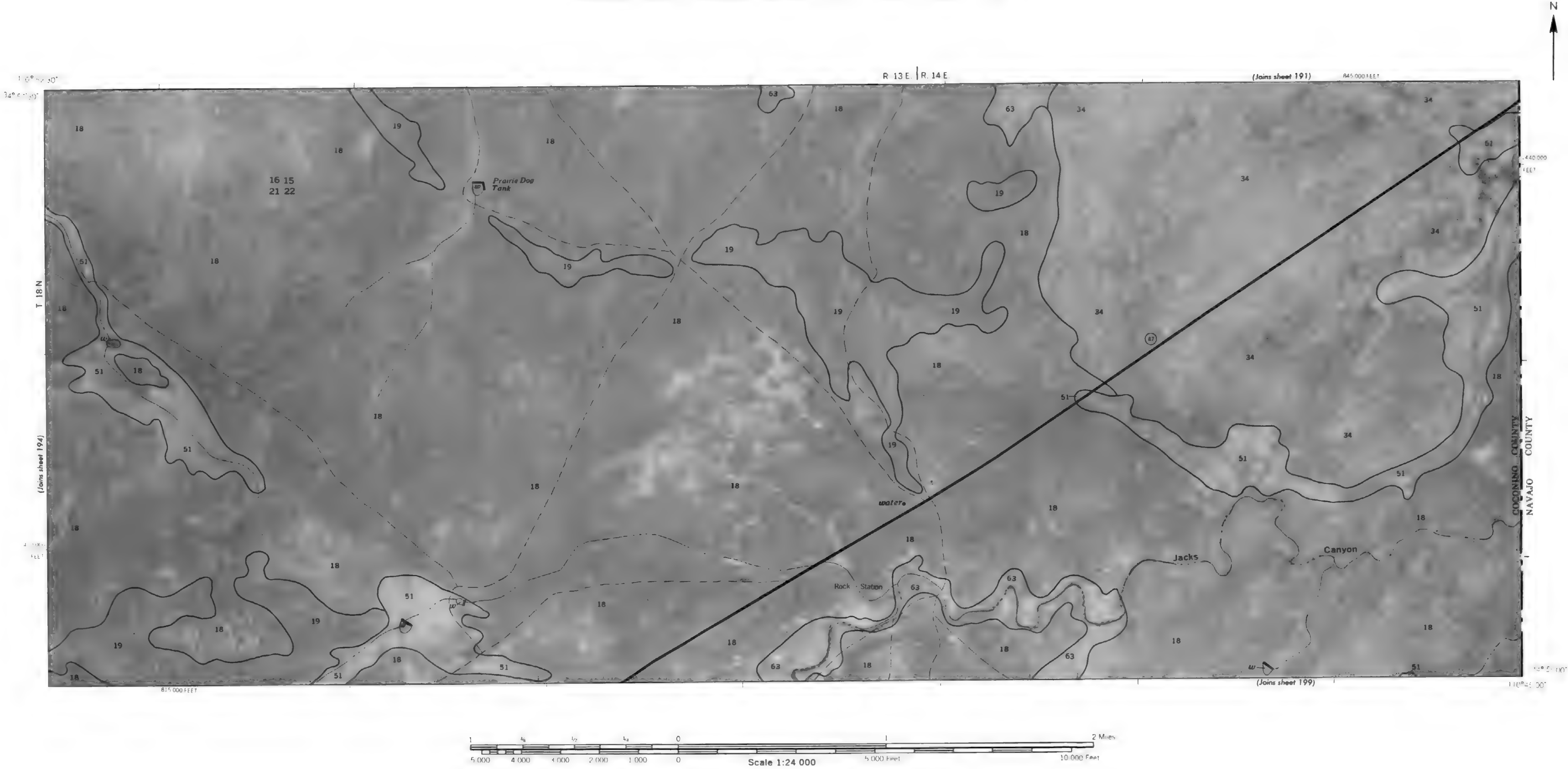




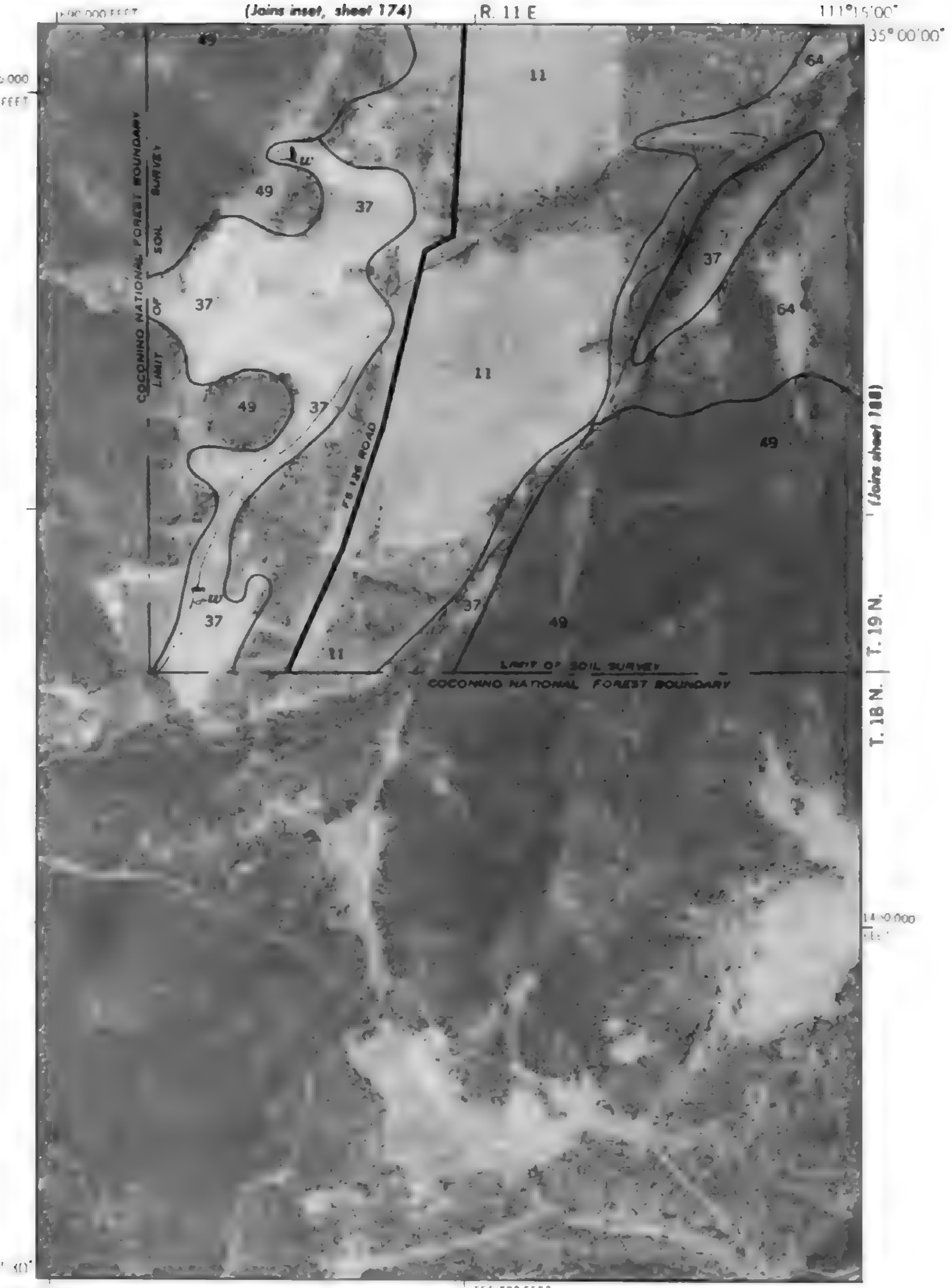
5,000 foot grid ticks based on state coordinate system. Land division corners (if shown) are approximately positioned

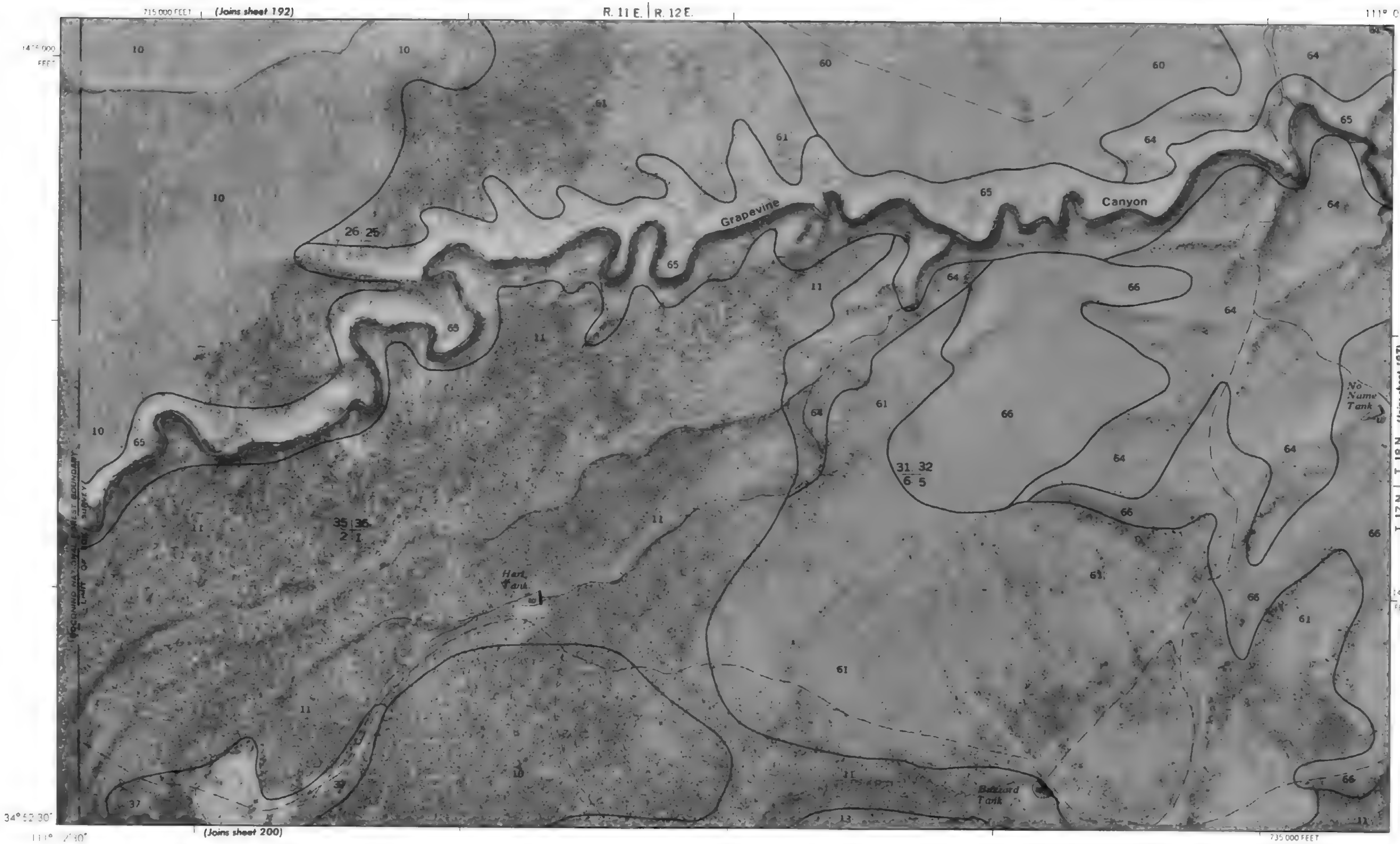
This map was compiled on 1972 and 1973 U.S. Department of the Interior, Geological Survey orthophotographs by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 195



INSET





1 ½ ¼ 0 1 2 Miles
5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet
Scale 1:24 000

This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotography by the U.S. Department of Agriculture Soil Conservation Service and cooperating agencies.
5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

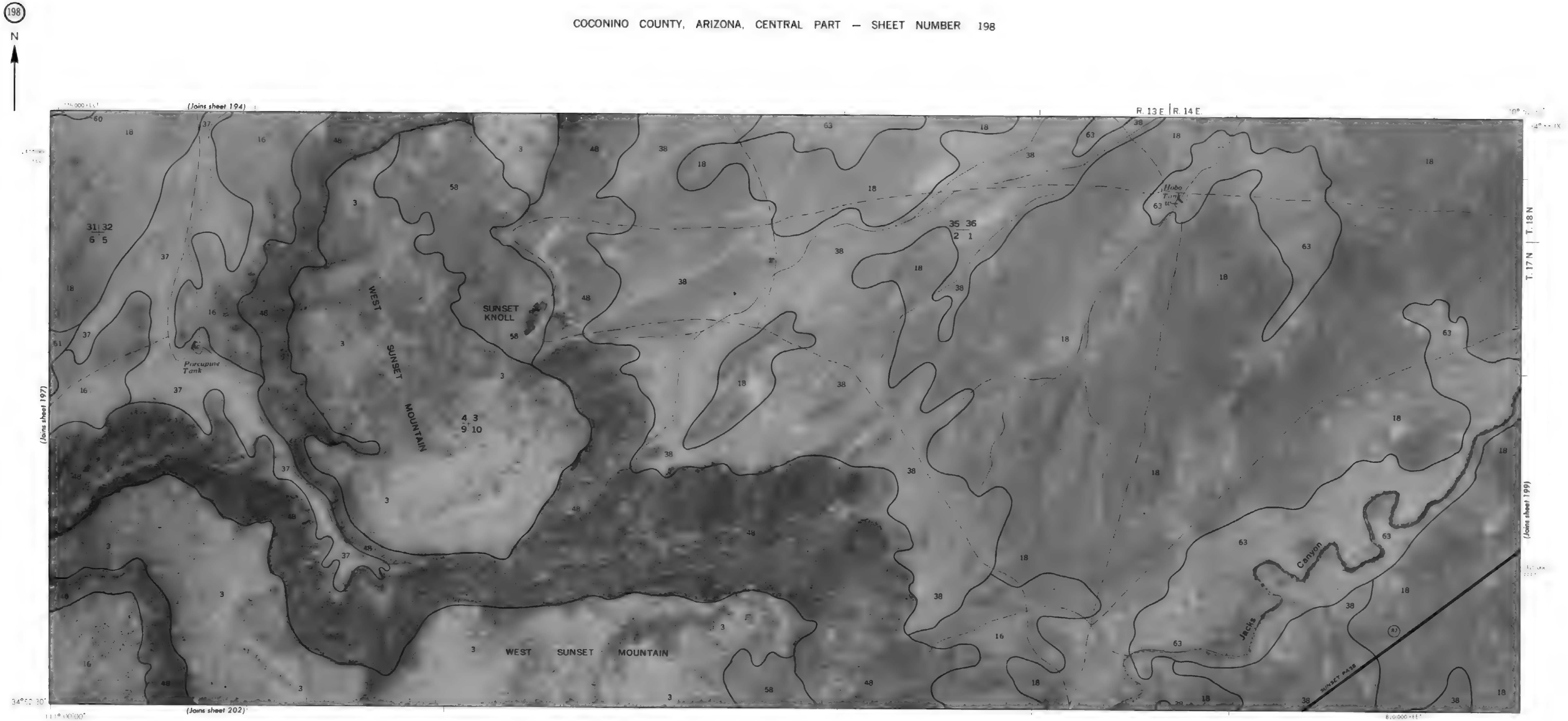
COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 196

197

N

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 197

Scale 1:24 000

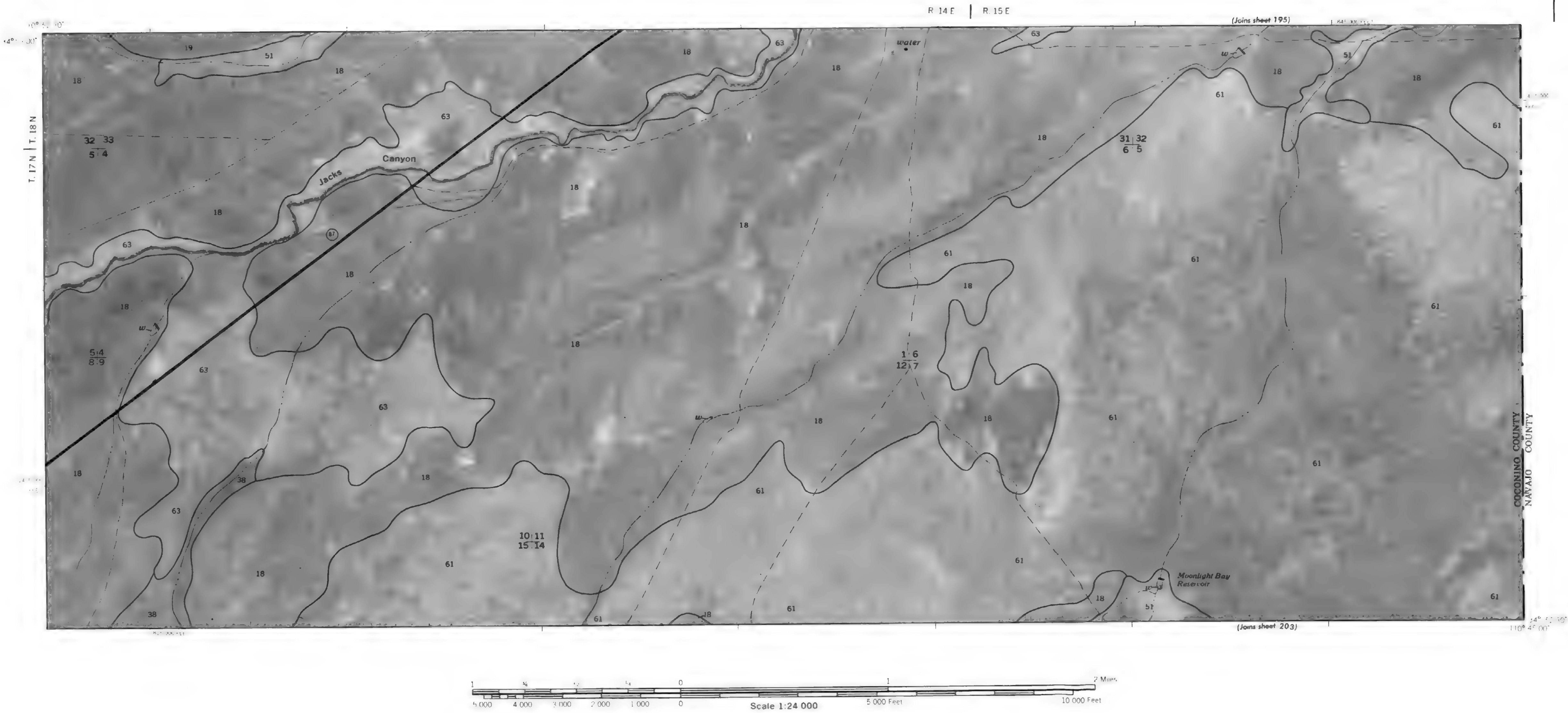


1 ½ ¼ ¼ 0 1 2 Miles
5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet
Scale 1:24 000

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 198

This map was compiled on 1972 and 1973 U.S. Department of the Interior, Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies

5,000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned

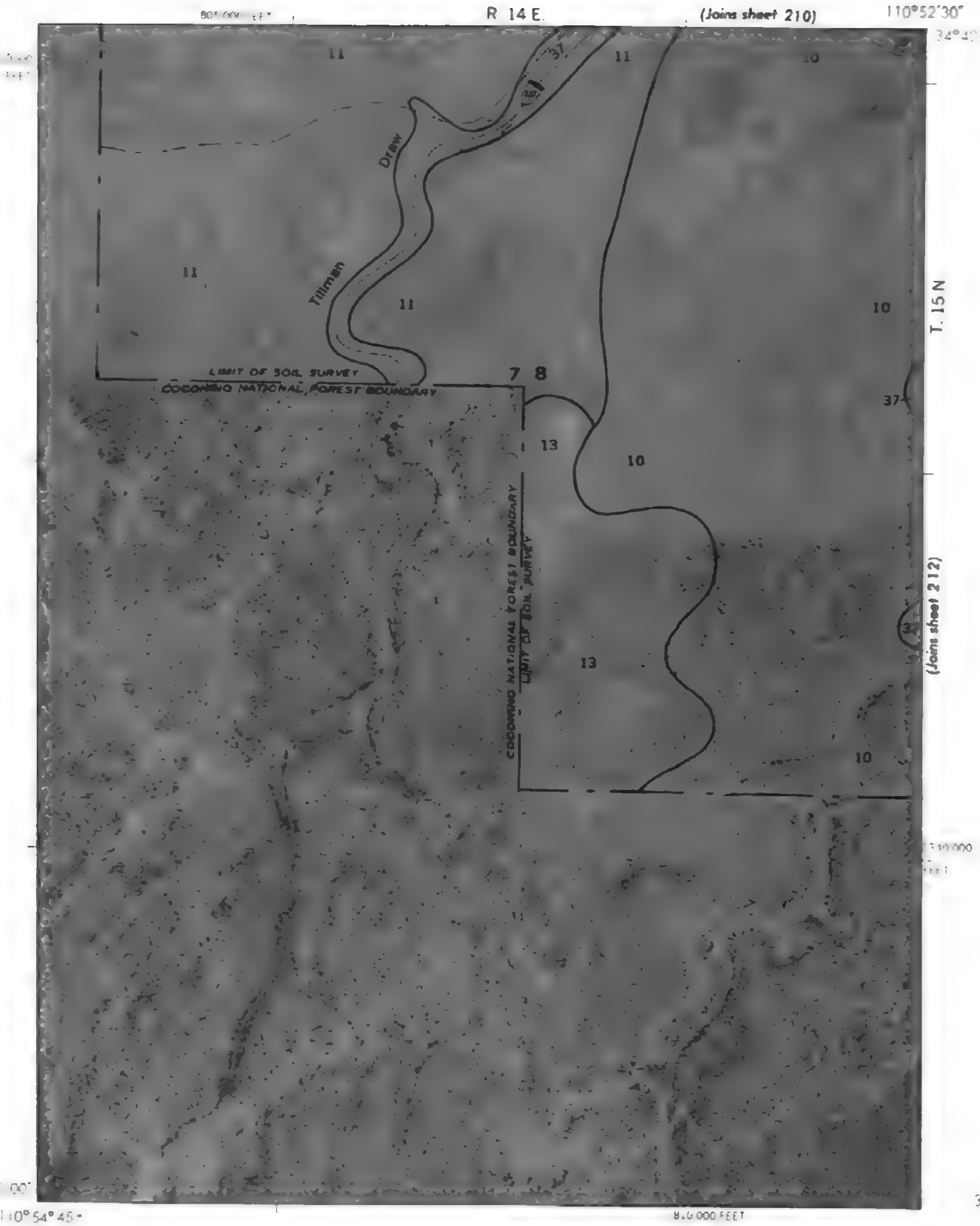


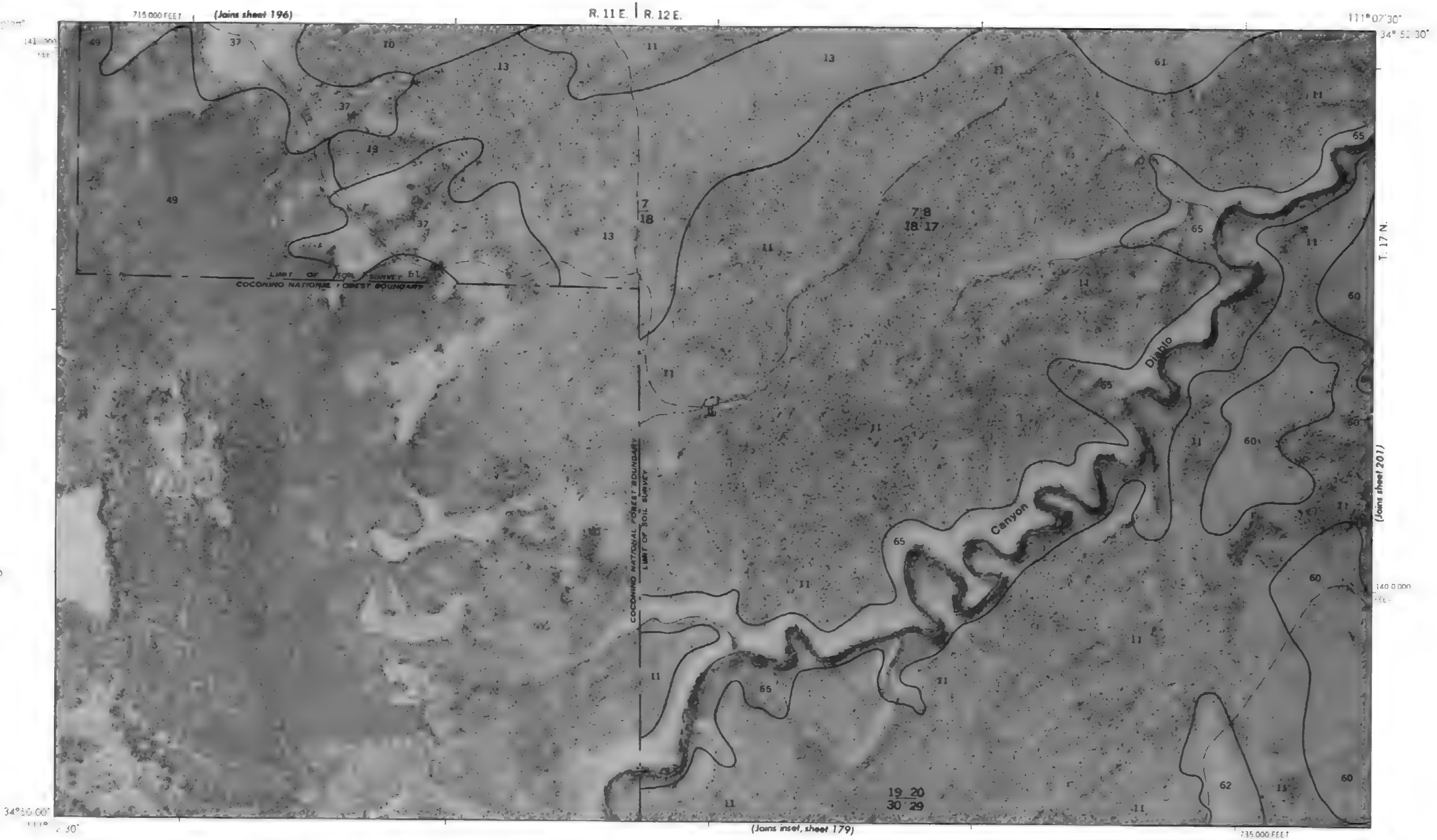
COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 199

COCONINO COUNTY, ARIZONA, CENTRAL PART — SHEET NUMBER 200

N

INSET





1 ¾ ½ ¼ 0 1 2 Miles

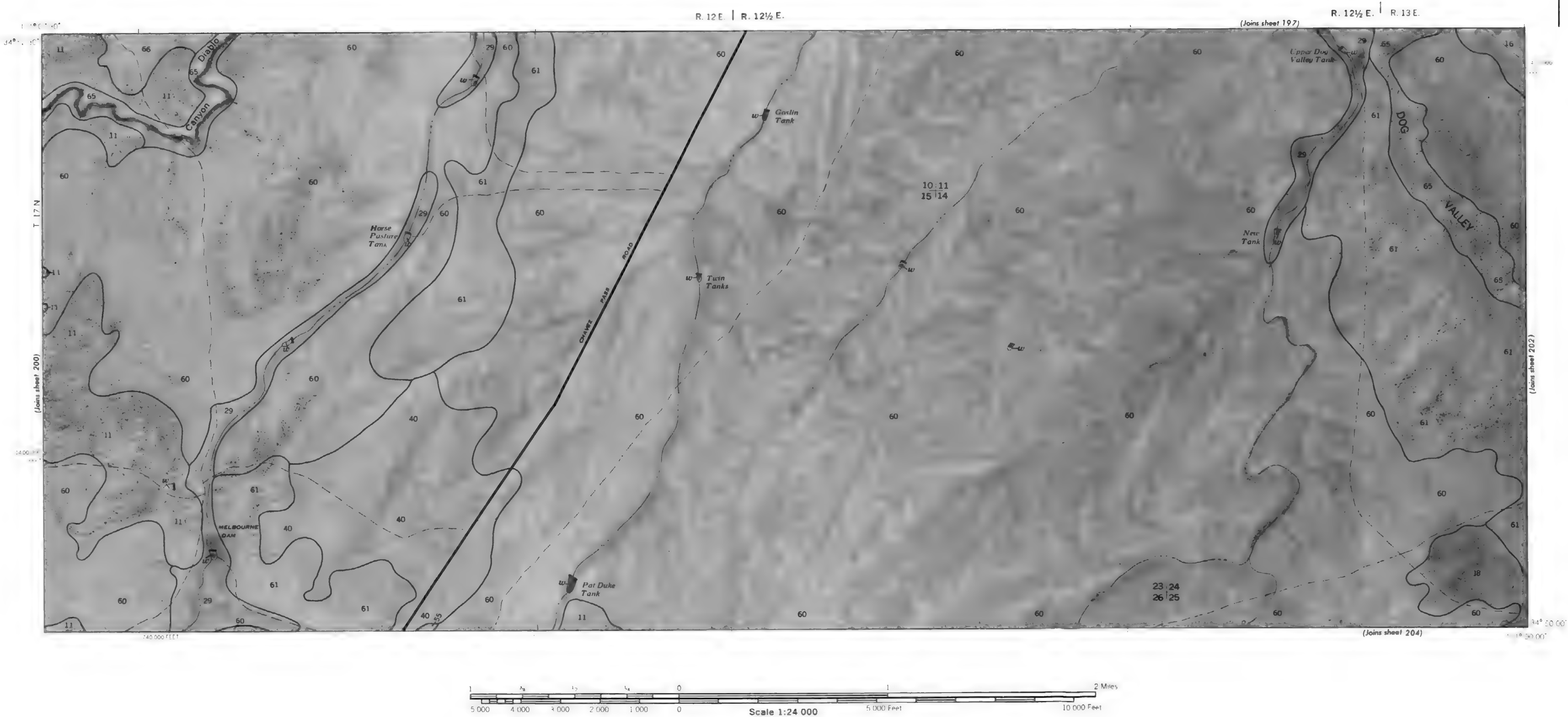
5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

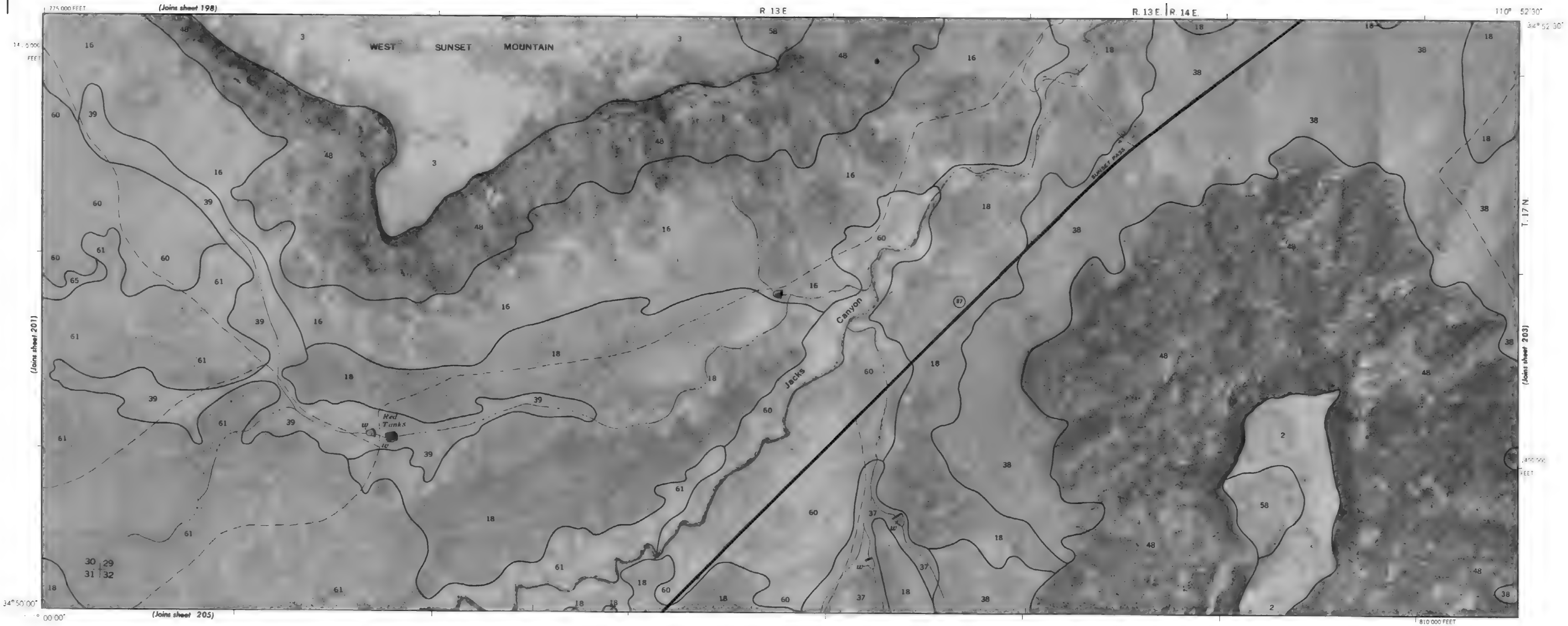
This map was compiled on 1973 and 1973 U.S. Department of the Interior Geological Survey orthophotographs by the U.S. Department of Agriculture Soil Conservation Service and cooperating agencies.

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 200



This map was compiled on 1972 and 1973 U.S. Department of the Interior, Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies
5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned

COCONINO COUNTY, ARIZONA, CENTRAL PART — SHEET NUMBER 202



Scale 1:24 000

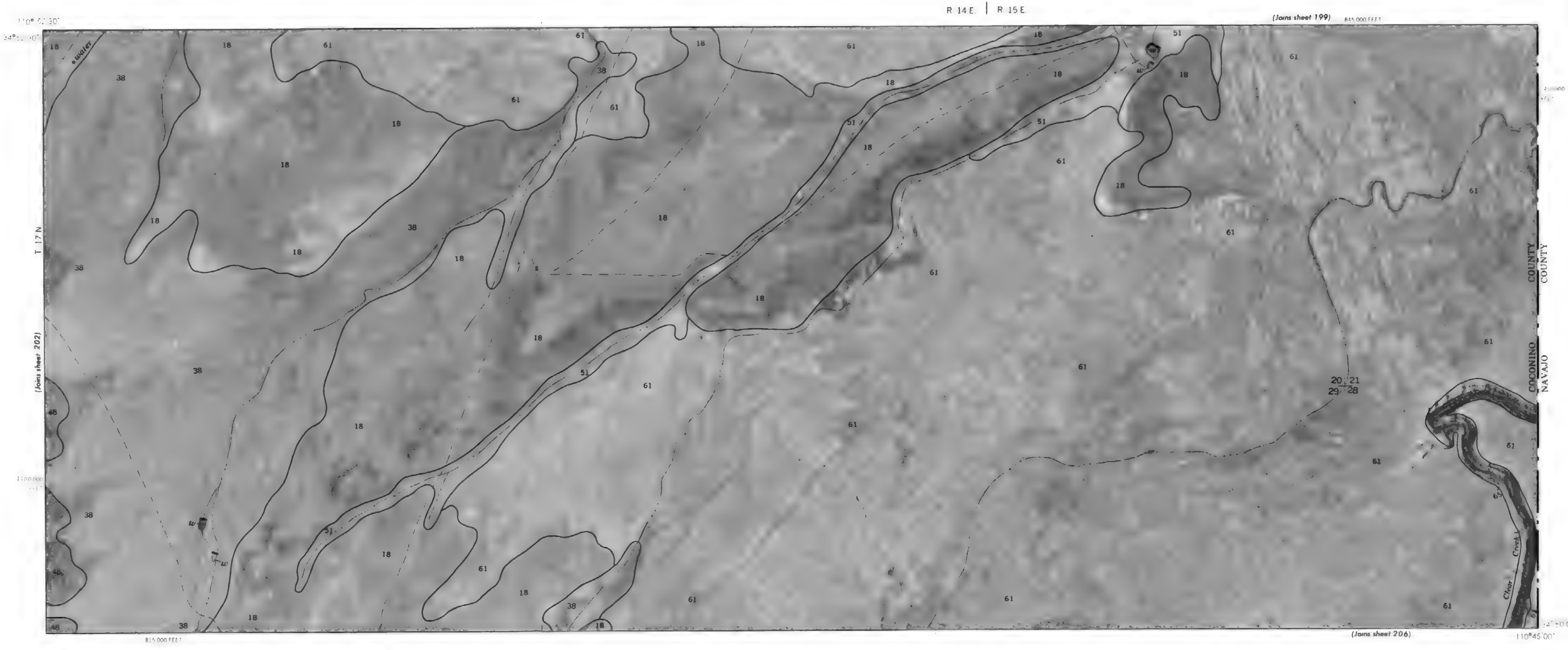
5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotography by the U.S. Department of Agriculture Soil Conservation Service and cooperating agencies.

203

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 203

This map is compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. 5,000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.



Scale 1:24 000

1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

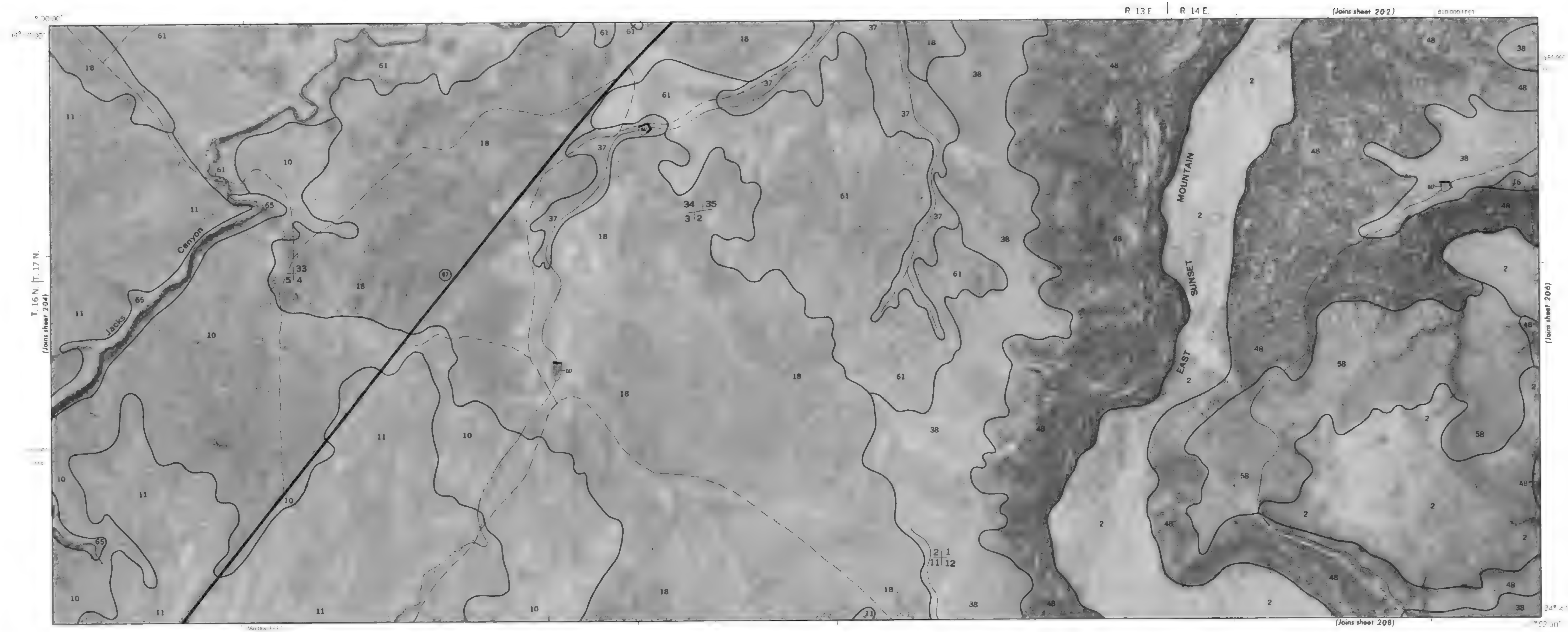
COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 204

205

N

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 205

This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. 5,000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.



Scale 1:24 000

1 ½ 0 1 2 Miles

5,000 4,000 3,000 2,000 1,000 0 5,000 Feet 10,000 Feet

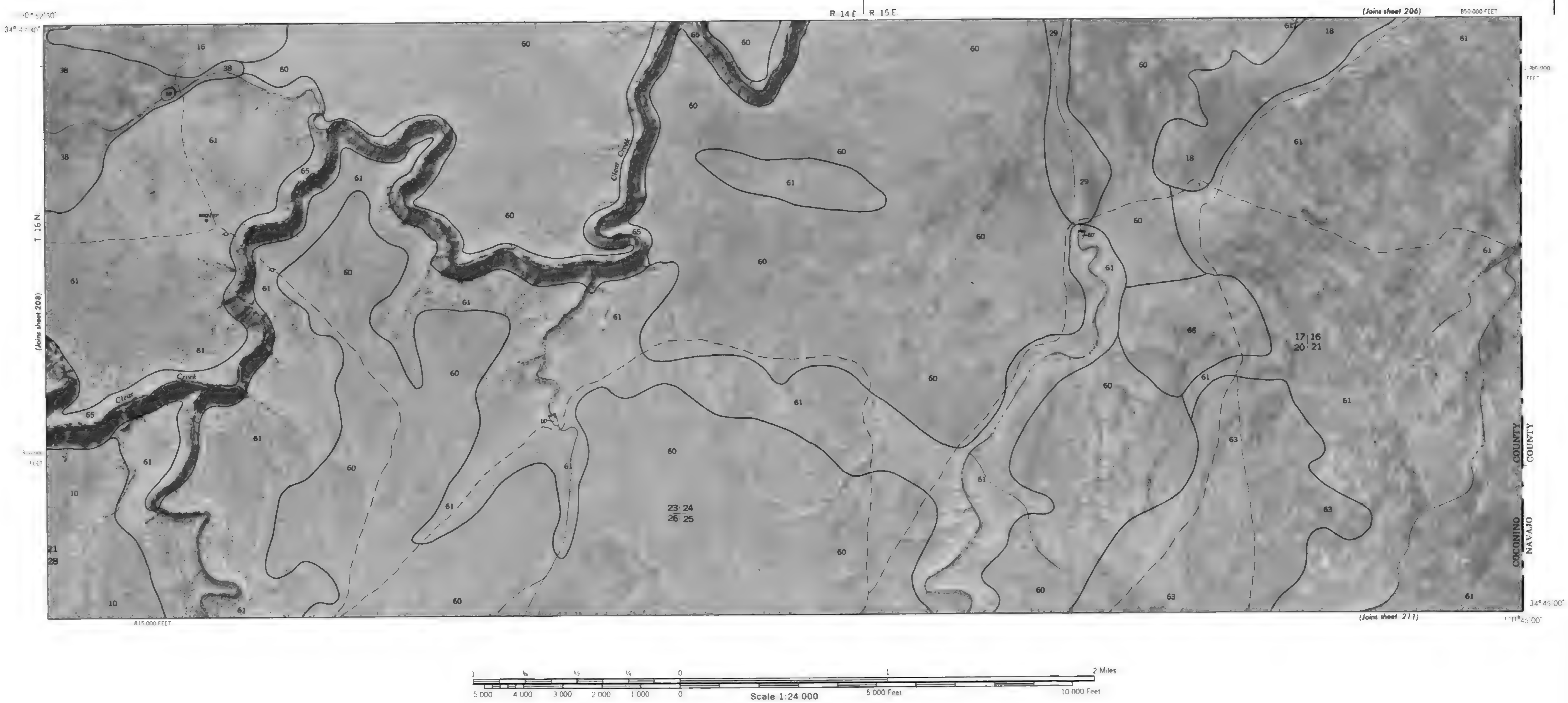
5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.
This map was compiled on 1972 and 1973 U.S. Department of The Interior Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 207

This map was compiled on 1972 and 1973 U.S. Department of The Interior, Geological Survey orthophotographs by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.



Scale 1:24 000

COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 209

This map was compiled on 1972 and 1973 U.S. Department of The Interior, Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

Scale 1:24 000

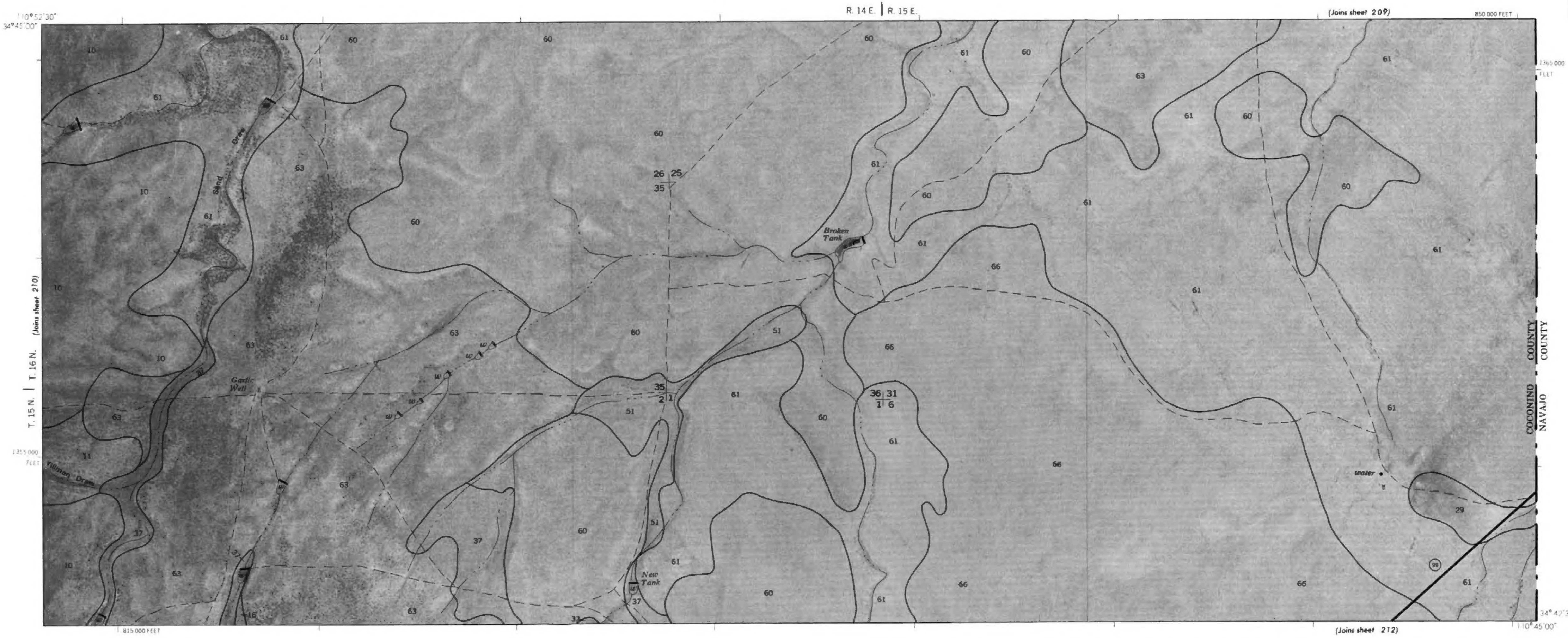
1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

COCONINO COUNTY, ARIZONA, CENTRAL PART — SHEET NUMBER 211



1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

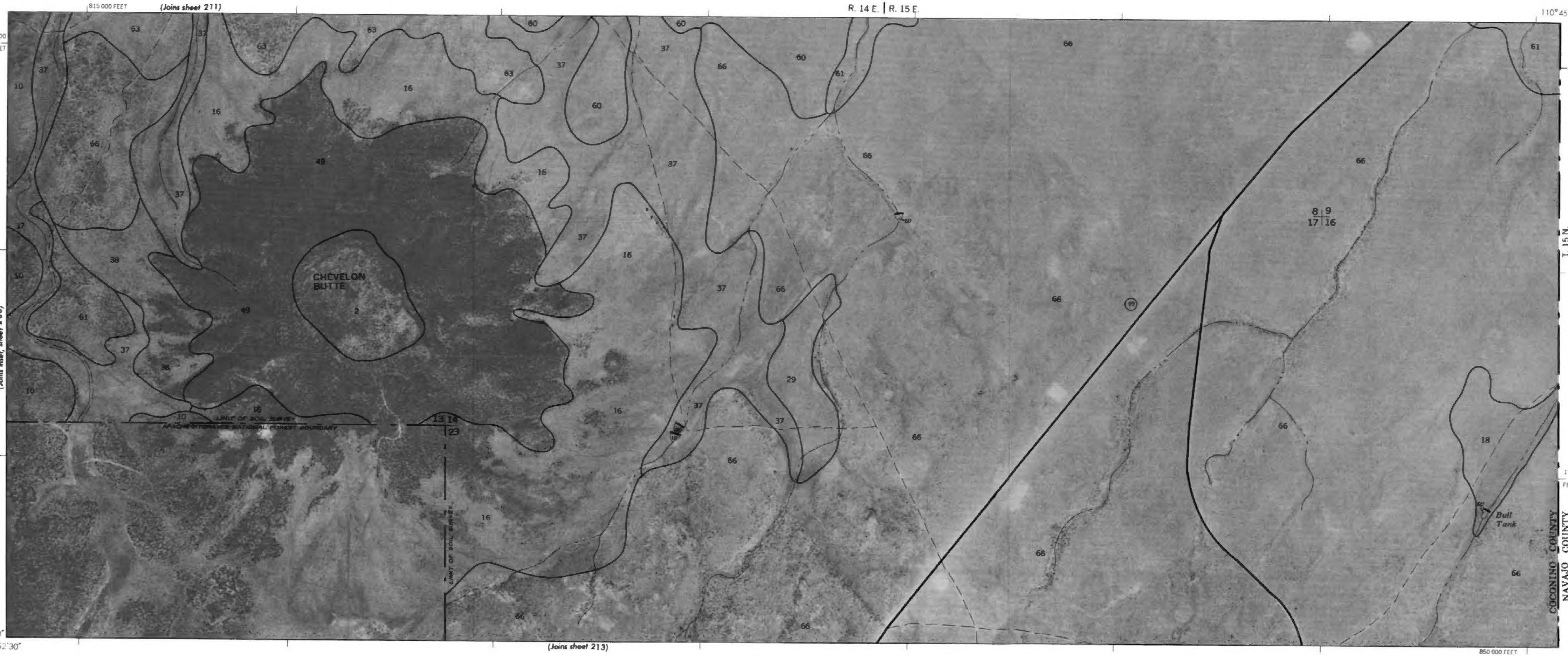
COCONINO COUNTY, ARIZONA, CENTRAL PART NO. 211

This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotography by the U.S. Department of Agriculture Soil Conservation Service and cooperating agencies

5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned

N

COCONINO COUNTY, ARIZONA, CENTRAL PART — SHEET NUMBER 212



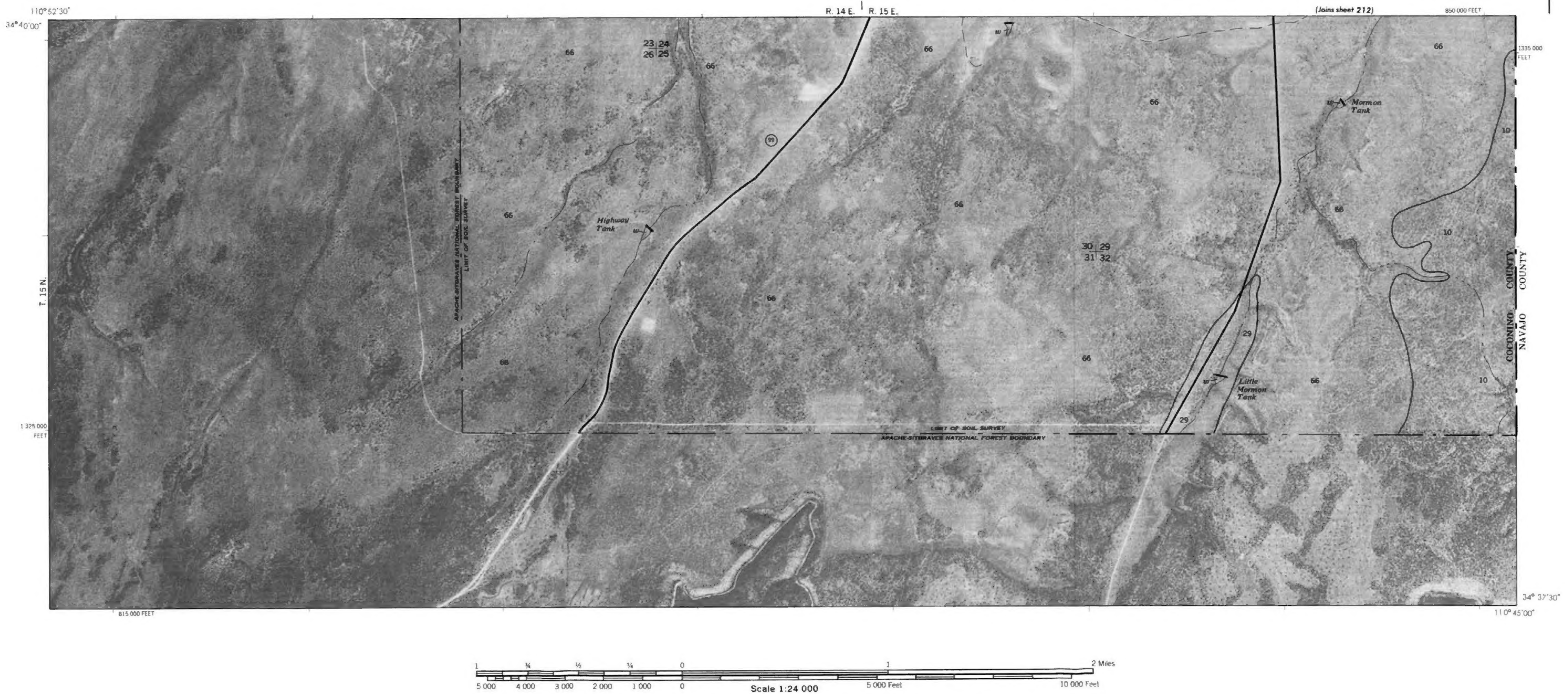
1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned

This map was compiled on 1972 and 1973 U.S. Department of the Interior Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies



This map was compiled on 1972 and 1973 U.S. Department of The Interior Geological Survey orthophotography by the U.S. Department of Agriculture Soil Conservation Service and cooperating agencies
5,000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned